Hemisphere®

875-0323-000

Vector VS330 GNSS Compass

User Guide

Revision: C2

October 17, 2017

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

This product complies with the essential requirements and other relevant provisions of Directive 2014/53/EU. The declaration of conformity may be consulted at https://hemispheregnss.com/About-Us/Quality-Commitment.

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6469663	7162348	7437230	8085196	8265826	2004320401
6501346	7277792	7460942	8102325	8271194	
6539303	7292185	7689354	8138970	8307535	
6549091	7292186	7808428	8140223	8311696	
6711501	7373231	7835832	8174437	8334804	
6744404	7388539	7885745	8184050	RE41358	
6865465	7400294	7948769	8190337		

Other U.S. and foreign patents pending.

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Contact your local dealer for technical assistance. To find the authorized dealer near you:

Hemisphere GNSS, Inc
8515 East Anderson Drive
Scottsdale, AZ 85255 USA
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Hemisphere GNSS, Inc.
8515 East Anderson Drive
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Table of Contents

Terms and Definitions

The following table lists the terms and definitions used in this document

Term	Definition
1PPS	1 pulse-per-second is a pulse that is output by the receiver precisely once a second and is used for hardware synchronization.
Activation	Activation refers to a feature added through a one-time purchase. For features that require recurring fees, see Subscription.
aRTK	aRTK is a Hemisphere GNSS exclusive service that uses Atlas to extrapolate the last RTK correction during an RTK outage so that the length of time an RTK position can be used after an RTK outage is extended.
Atlas	Atlas is a subscription based service provided by Hemisphere that enables the VS330 to achieve sub-decimeter accuracy after a twenty-minute convergence period without the need for a base station or datalink.
Base Station	The Base Station is a receiver placed over a familiar point. The base station then provides real-time observations and sends these to nearby RTK rovers via UHF radio or the internet. The RTK rover (such as a VS330) is then able to use information contained in these messages to calculate a differential correction and improve accuracy.
BeiDou	BeiDou is a Chinese satellite based navigation system. Global coverage is expected by 2020.
Datalink	Datalink is the device used to send RTK or DGNSS corrections from a base station to one of more rovers. Common datalinks are UHF radio or Ntrip (see Ntrip).
DGPS/DGNSS	Differential GPS/GNSS refers to a receiver using Differential Corrections.
Differential Corrections	Differential Corrections improve the precision of a GNSS rover. Two GNSS receivers placed in a nearby area will have similar error. A base station is placed over a known point. Since the actual position of the base station is known, error can be calculated and corrections can then be applied to nearby rovers. This differs from RTK (see RTK).
Dual-Frequency	Dual-Frequency use both L1 and L2 signals from GPS satellites, G1 and G2 signals from GLONASS satellites, and B1 and B2 signals from BeiDou satellites. Single frequency receivers will only use L1, G1, and B1.
EGNOS	European Geostationary Navigation Overlay Service (EGNOS) is a satellite-based augmentation system (SBAS) that provides free differential corrections over satellite in parts of Europe.

Terms and Definitions (continued)

Elevation Mask	Elevation Mask is the minimum angle between a satellite and the horizon for the receiver to use that satellite in the solution. Satellites near the horizon often provide noisy signals and should be avoided.
Firmware	Firmware is the software loaded into the receiver that controls the functionality of the receiver and runs the GNSS engine.
GAGAN	GPS Aided Geo Augmented Navigation (GAGAN) is a satellite based augmentation system (SBAS) that provides free differential corrections over satellite in India.
GLONASS	Global Orbiting Navigation Satellite System (GLONASS) is a Global Navigation Satellite System (GLONASS) deployed, and maintained, by Russia. It is comparable to the United States' GPS system.
GNSS	Global Navigation Satellite System (GNSS) is a system that provides autonomous 3D position (latitude, longitude, and altitude) along with very accurate timing globally by using satellites. Current GNSS providers are: GPS, GLONASS and Galileo. BeiDou is expected to have global coverage by 2020.
GPS	Global Positioning System (GPS) is a global navigation satellite system implemented by the United States.
Heading	Heading is the angle between true north and the vector calculated from the primary to secondary antenna.
Heading Bias	Heading Bias is an offset applied to the heading value the receiver calculates. This can be used if the antennas are installed in such a way that the vector created from the primary to secondary antenna does not match up with the centerline of the vessel.
Mountpoint	Mountpoints are the specified data streams in Ntrip. Multiple base stations may send data to an Ntrip caster. Each base station has a unique Mountpoint. Therefore, an Ntrip client must specify from which mountpoint the Ntrip client will receive data.
Multipath	Multipath occurs when the GNSS signal reaches the antenna by two or more paths. This causes incorrect psuedorange measurements and leads to less precise GNSS solutions.
NMEA	National Marine Electronics Association (NMEA) is a marine electronics organization that sets standards for communication between marine electronics.

Terms and Definitions (continued)

Ntrip	Networked Transport of RTCM via Internet Protocol (Ntrip) is a protocol for streaming GNSS data over the internet. Ntrip is most often used to stream RTK or DGNSS corrections over the internet.
Ntrip Caster	Ntrip casters receive data from one or more Ntrip servers and the data is available to one or more Ntrip clients. Each data source (Ntrip server) must send the data to a specified Ntrip mountpoint, and the Ntrip client must specify which mountpoint to receive data from. This allows multiple base stations on the same network.
Ntrip Client	Ntrip clients receive data from the Ntrip caster and provide this data (often over GSM or serial) to the GNSS receiver.
Ntrip Server	The Ntrip server sends data from the Ntrip source (base station) to the Ntrip caster.
ROX	ROX is a Hemisphere GNSS propriety RTK message format that can be used as an alternative to RTCM3 when both the base and rover are Hemisphere branded.
RTCM	Radio Technical Commission for Maritime Services (RTCM) is a standard used to define RTK message formats so that receivers from any manufacturer can be used together.
RTK	Real-Time-Kinematic (RTK) is a real-time differential GPS method that provides better accuracy than differential corrections.
SBAS	Satellite Based Augmentation System (SBAS) is a system that provides differential corrections over satellite throughout a wide area or region.
Signal-to-Noise Ratio	Signal-to-Noise Ratio (SNR) is the ratio of the message content of the signal against the noise of the signal.
Subscription	A subscription is a feature that is enabled for a limited time. Once the end-date of the subscription has been reached, the feature will turn off until the subscription is renewed.
WAAS	Wide Area Augmentation System (WAAS) is a satellite-based augmentation system (SBAS) that provides free differential corrections over satellite in parts of North America.

Chapter 1: Introduction

Product Overview

Key Features

What's Included in your Kit

Firmware Upgrades

Introduction

This User Guide provides information to help you quickly set up your Vector™ VS330™ GNSS compass.

Note: Throughout the rest of this user guide the Vector™ VS330™ GNSS Compass is referred to simply as the VS330.

Product Overview

Based on Eclipse™ GNSS technology, the VS330 is designed for marine and land applications that require precise heading and RTK position performance. Featuring a Hemisphere GNSS Eclipse Vector-based receiver and two separate antennas, VS330 achieves heading accuracy ranging from 0.01º to 0.17º RMS (depending on the antenna separation) and offers robust positioning performance.

The standard model VS330 tracks single frequency GPS, GLONASS, and BeiDou . The VS330 can be upgraded via activations and/or subscriptions to support multi-frequency GPS, GLONASS and BeiDou as well as Athena RTK and Atlas L-band. VS330 supports raw data logging to a removable USB flash drive for post processing.

Athena RTK

Athena RTK (Real Time Kinematic) technology is available on Eclipse-based GNSS receivers. This is Hemisphere's most advanced RTK processing software, and can be added to the VS330 as an activation.

Athena RTK has the following benefits:

- **Improved Initialization time** - Performing initializations in less than 15 seconds at better than 99.9% of the time
- **Robustness in difficult operating environments -** Extremely high productivity under the most aggressive of geographic and landscape oriented environments
- **Performance on long baselines -** Industry-leading position stability for long baseline applications

Atlas L-band

Atlas L-band is Hemisphere's industry leading correction service, which can be added to the VS330 as a subscription. Atlas L-band has the following benefits:

- **Positioning accuracy -** Competitive positioning accuracies down to 4 cm RMS in certain applications
- **Positioning sustainability -** Cutting edge position quality maintenance in the absence of correction signals, using Hemisphere's patented technology
- **Scalable service levels -** Capable of providing virtually any accuracy, precision and repeatability level in the 4 to 100 cm range
- **Convergence time -** Industry-leading convergence times of 10-40 minutes

For more information about Athena RTK, see: http://hemispheregnss.com/Technology
For more information about Atlas L-band, see: http://hemispheregnss.com/Atlas

Key Features

Key features of the VS330 include:

- High precision RTK positioning
  (Horizontal RMS 10mm + 1ppm, Vertical RMS 20mm + 2ppm)
- DGNSS corrections from all SBAS constellations and over beacon
- Position accuracies of 4cm horizontal RMS/8cm vertical RMS without the need of a base station by using Atlas L-band*
  *Requires the purchase of a subscription
- Heave of 30 cm RMS (DGNSS), 10 cm (RTK)
- Heading accuracy ranging from 0.01º to 0.17º RMS (depending on the antenna separation) without the need of RTK or DGNSS
- Pitch and roll < 1° RMS
- Simple menu operations
- 1 PPS output
- Event marker input
- 2 full-duplex RS232 and 1 half-duplex RS422 serial ports for RTK input/output, NMEA 0183 output, and serial configuration
- 1 USB port for logging raw GNSS data for post processing, logging diagnostic data, or configuring the receiver
- 20 Hz output (with activation)
- Accurate heading up to 3 minutes during GNSS outages
- Integrated gyro and tilt sensors deliver fast startup times and provide heading updates during temporary loss of GNSS

What's Included in Your Kit

Your VS330 kit (Figure 1-1) includes the following parts:

- VS330 receiver and related mounting hardware
- Power and data cables

Note: The standard VS330 kit does not include antennas, antenna mounting hardware, and antenna cables since receiver options vary.

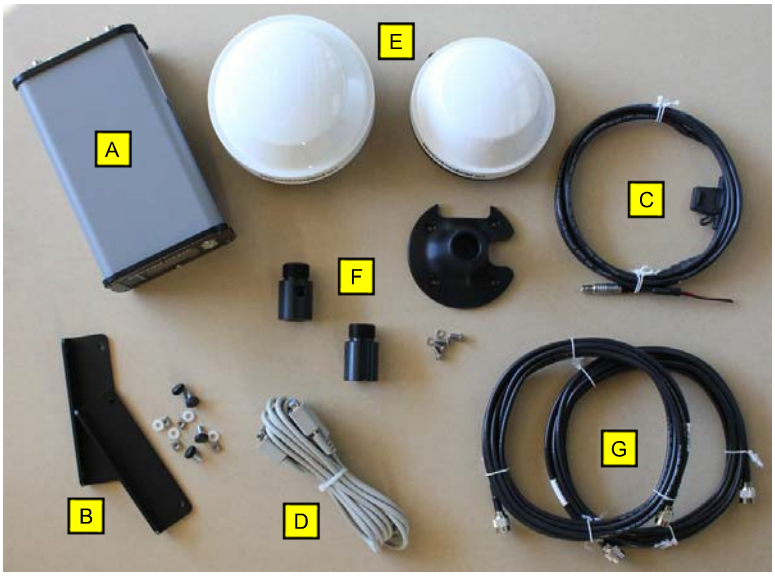


Figure 1-1: VS330 System Parts diagram

Table 1-1 provides the description and part number of each part in your kit.

Review the parts shipped with your kit. If any parts are damaged, contact your freight carrier. If any parts are missing, contact your dealer.

Table 1-1: Parts List

Item	Part Name	Qty	Part Number
A	VS330 receiver	1	803-3028-0
B	Receiver mounting kit (two brackets and related hardware)	1	710-0056-000#
C	Power cable, circular	1	054-0146-000#
D	Data cable, DB-9 female to DB-9 male, 3 m	1	050-0011-022#
The following are available for purchase separately from the standard VS330 kit.			
E	Antenna (quantity of each based on your purchased configuration) A42 A43 A52 A45		804-3045-000# 804-3046-000# 804-3038-000# 750-9006-0-
F	Antenna mounting kit (quantity of each based on your purchased configuration) A42 A43 A52 *Note: Your kit may not include a mag mount.*		710-0110-000# 710-0111-000# 710-0097-000#
G	Antenna cable, TNC male to TNC male, 5 m	2	052-0005-000#

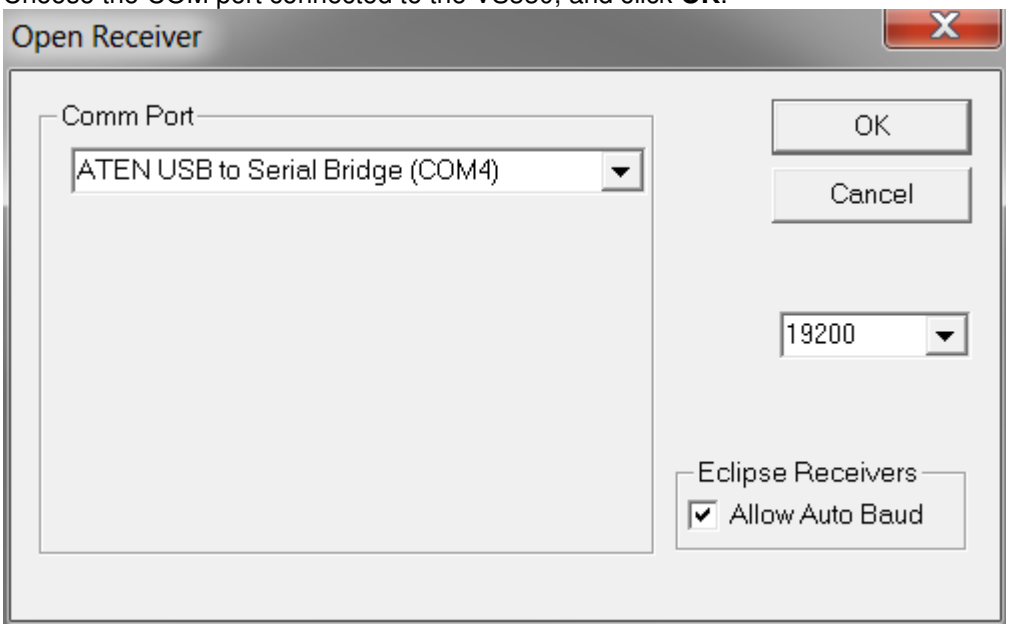
Firmware Upgrades

Firmware Upgrades

Periodically, Hemisphere GNSS releases firmware upgrades to improve performance, fix bugs, or add new features to a product. To update the firmware on the VS330, download the latest version of Hemisphere GNSS RightArm from the following link:
https://hemispheregnss.com/Resources-Support/Software

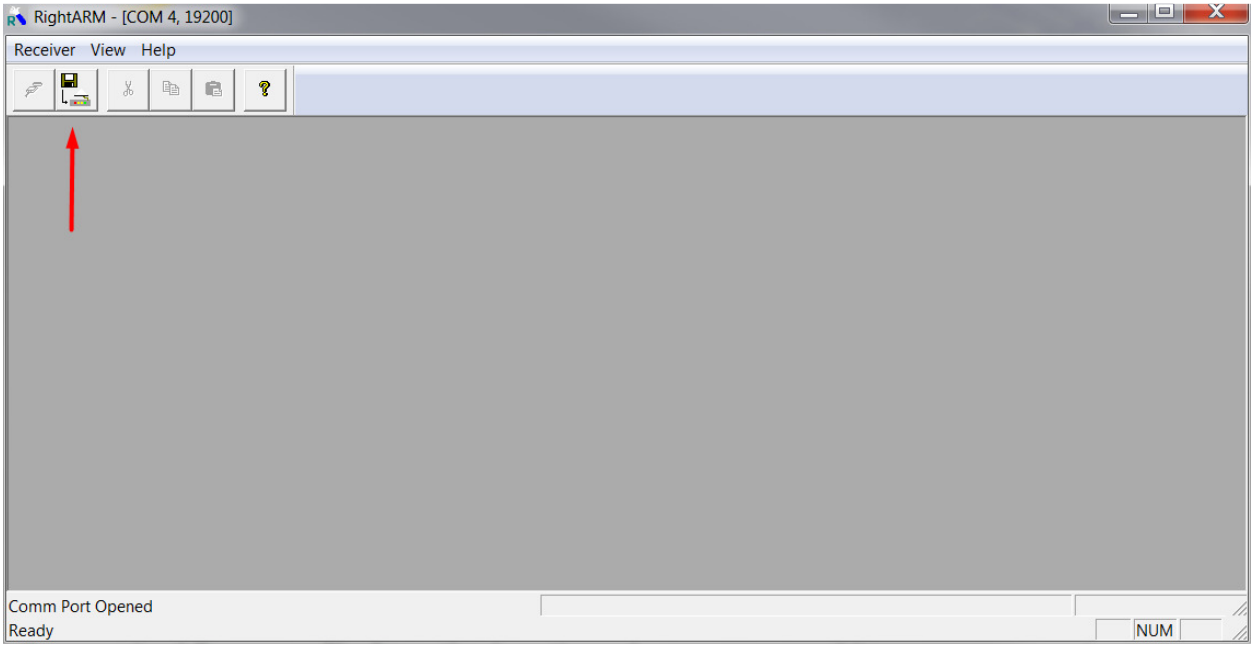
Connect the VS330 to a computer over serial. Firmware can be loaded over either serial port. Set the baud rate of the serial port you are using to 19200. Launch RightArm. Click on the **Connect** button or go to Receiver -> Connect.

Choose the COM port connected to the VS330, and click **OK**.



Note: The baud rate of the serial port should be set to 19200 bps. Select “Allow Auto Baud” to enable the receiver to change the baud rate during the firmware upgrade for a faster update.

Click on the **Programming** button.



Select a ‘Program Type.’

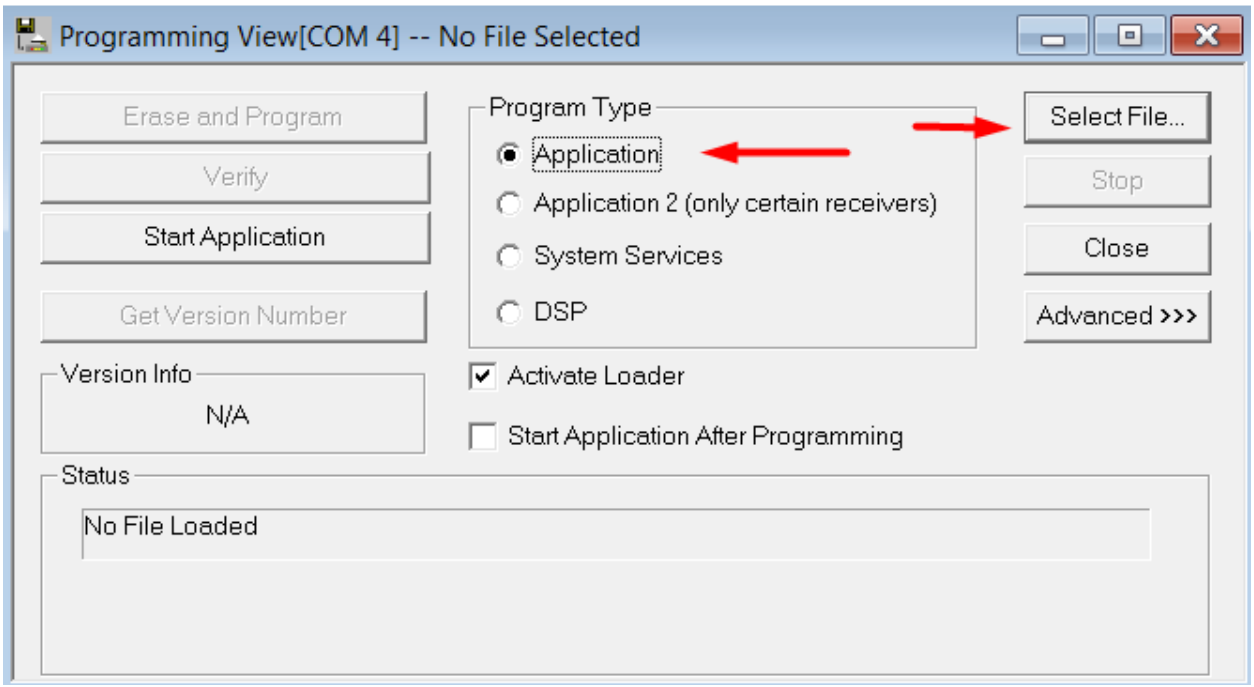
The VS330 has two firmware applications, allowing two different versions of GNSS firmware. Hemisphere GNSS suggests loading the new firmware onto both applications.

After the firmware update is completed, check the current GNSS firmware.

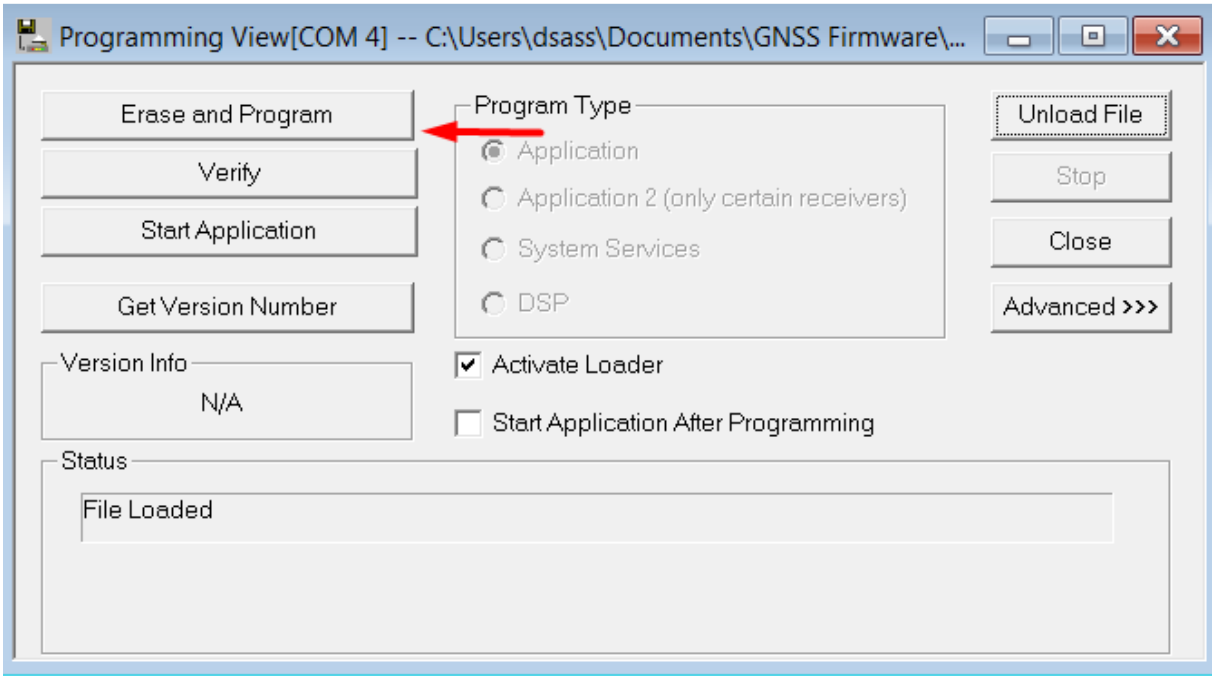
If the current firmware is not the same as the newly loaded firmware, the VS330 could be using the other application. You can switch applications by sending the following command:

$JAPP,OTHER.

Choose the Application, and press **Select File** to select the firmware file.

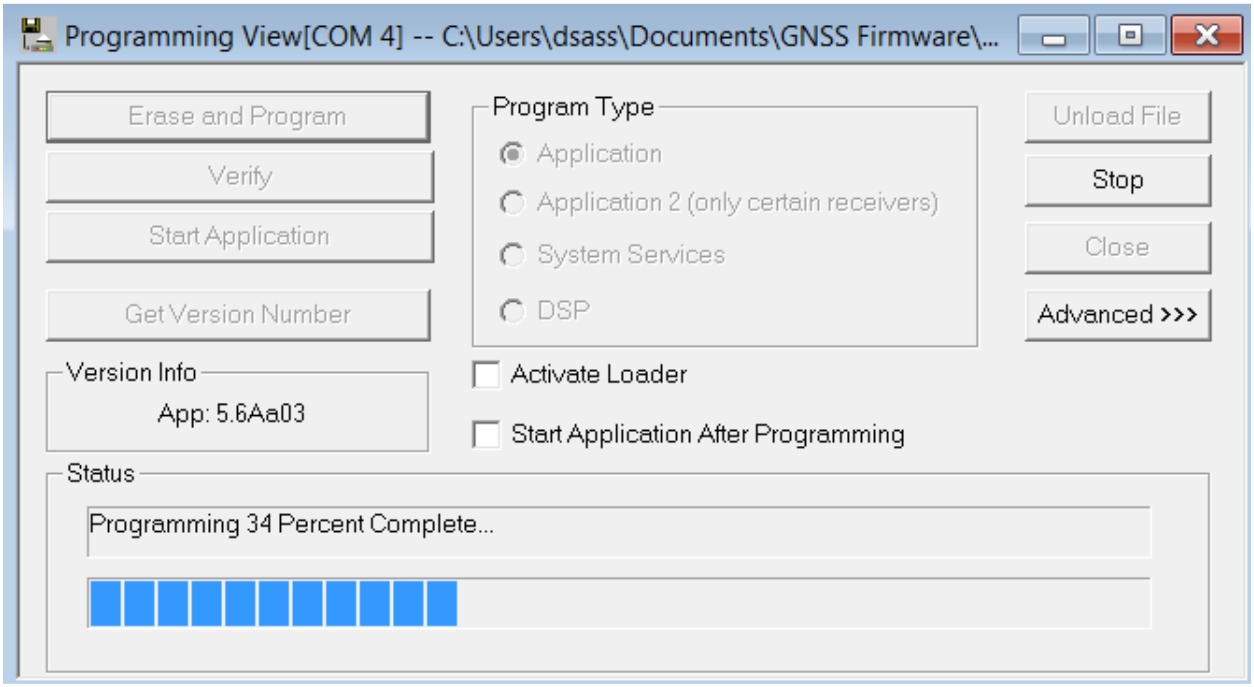


Choose the firmware, and click **Erase and Program**.



Note: Before clicking the Erase and Program button, the Activate Loader check box in the Programming View window is selected. After pressing the Erase and Program button, the check box should be cleared and the Status field should show that the receiver is in loader mode and ready to receive the new firmware file. If the Activate Loader check box remains selected, power the receiver off and on. When the receiver powers back on, the Activate Loader box should be de-selected.

WARNING: Do not to interrupt the power supply to the receiver, and do not interrupt the communication link between the PC and the receiver until programming is complete. Failure to do so may cause the receiver to become inoperable and will require it to be returned to the factory for repair.



After completing the firmware update, Hemisphere GNSS suggests repeating this process for the other application.

Chapter 2: Understanding the VS330

Differential or RTK Operation

SBAS Tracking

Supplemental Sensors

Time Constants

Understanding the VS330

The GNSS receiver begins tracking satellites when it powers up and an antenna has connected to the antenna port on the receiver. Position and heading accuracy vary depending on location and environment. Position performance can be improved with RTK or DGNSS.

The following sections provide the steps to configure your VS330 to use Atlas, Beacon, SBAS, or RTK.

Note: Differential source and RTK status have no impact on heading, pitch, or roll. They only have an impact on positioning and heave.

Differential or RTK Operation

The purpose of differential GNSS (DGNSS) and RTK is to remove the effects of atmospheric errors, timing errors, and satellite orbit errors, while enhancing system integrity.

Autonomous positioning capabilities of the VS330 will result in positioning accuracies of 2.5 m 95% of the time. To improve positioning quality the VS330 can receive DGNSS corrections over SBAS or Beacon, can receive L-band corrections with Hemisphere GNSS' Atlas L-band technology, or receive RTK corrections over serial.

For more information on the differential services and the associated commands refer to the Hemisphere GNSS Technical Reference .

SBAS Tracking

The VS330 automatically scans and tracks SBAS signals without the need to tune the receiver. The VS330 features two-channel tracking that provides an enhanced ability to maintain a lock on an SBAS satellite when more than one satellite is in view. This redundant tracking approach results in more consistent tracking of an SBAS signal in areas where signal blockage of a satellite is possible.

SBAS comes with the VS330 as a standard feature and does not require an activation or subscription code.

SBAS can be configured through the menu display of your VS330. For further details, please see Figure C-3.

Beacon Operation

Many marine authorities, such as coast guards, have installed networks of radio beacons that broadcast DGNSS corrections to users of this system. With the increasing utility of these networks for terrestrial applications, there is an increasing trend toward densification of these networks inland. The dual channel beacon receiver in the VS330 can operate in manual or automatic tuning mode, or, using database mode, will select the closest station in compliance with IEC 61108-4 standards.

To configure the VS330 for beacon, connect the beacon capable antenna to the **secondary antenna port**. Then use Figure C-5 to configure the VS330 for beacon use.

Athena RTK

Athena RTK requires the use of two separate receivers: a stationary base station (primary receiver) that broadcasts corrections over a wireless link to the rover (secondary receiver).

The VS330 can use RTK brought in through either serial port. The receiver will use any RTK message coming in over a serial port if the RTK message type is included in the list of available differential sources. Refer to Figure C-4 for including a differential type (ROX, RTCM3, or CMR). If you do not know which RTK message type is being sent by the base station, you can include RTCM3, ROX, and CMR. Including extra differential sources will not affect the receiver if those differential sources are not being received.

Once the differential source has been set, configure the baud rate of the serial port receiving the RTK corrections. Ensure that the serial port configuration of the external device (such as radio or modem) is 8 bits/byte, 1 stop bit, no parity and no flow control.

Connect the external device to the serial port of the VS330. Some cables may require the use of a gender changer and/or null modem adapter.

Atlas L-band

Atlas L-band corrections are available worldwide. With Atlas, the positioning accuracy does not degrade as a function of distance to a base station, as the data content is not composed of a single base station's information, but an entire network's information. The VS330 can calculate a position with 4cm RMS (horizontal) accuracy in an industry-leading time of 20 minutes.

To configure the receiver to use Atlas L-band, a subscription must be purchased. Then use Figure C-6 to configure your receiver to use Atlas.

GLONASS & BeiDou

VS330 is available in its base form as L1 GPS G1 GLONASS, and B1 BeiDou. By adding multi-frequency GPS, GLONASS and BeiDou, the number of available signals increases, thereby improving the ability to obtain and maintain a heading solution. For a heading calculation, GPS, GLONASS and BeiDou satellites are used interchangeably, as intersystem biases cancel inside the VS330—this translates into being able to work in more obstructed areas and maintain a GNSS heading solution.

Supplemental Sensors

The VS330 has an integrated gyro and two tilt sensors, which are enabled by default. Each supplemental sensor may be individually enabled or disabled. Both supplemental sensors are mounted on the printed circuit board inside the VS330.

The sensors act to reduce the RTK search volume, which improves heading startup and reacquisition times. This improves the reliability and accuracy of selecting the correct heading solution by eliminating other possible, erroneous solutions.

The Hemisphere GNSS Technical Reference Guide describes the commands and methodology required to recalibrate, query, or change the sensors status.

Tilt Aiding

The VS330's accelerometers (internal tilt sensors) are factory calibrated and enabled by default. This constrains the RTK heading solution beyond the volume associated with just a fixed antenna separation. This is because the VS330 knows the approximate inclination of the secondary antenna with respect to the primary antenna. The search space defined by the tilt sensor will be reduced to a horizontal ring on the sphere's surface by reducing the search volume. This considerably decreases startup and reacquisition times (see Figure 2-1).

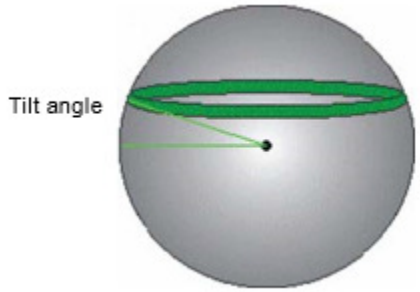


Figure 2-1: VS330's Tilt Aiding

Gyro Aiding

The VS330's internal gyro offers several benefits. It reduces the sensor volume for an RTK solution. This shortens reacquisition times when a GNSS heading is lost because the satellite signals were blocked. The gyro provides a relative change in angle since the last computed heading, and, when used in conjunction with the tilt sensor, defines the search space as a wedge-shaped location (see Figure 2-2).

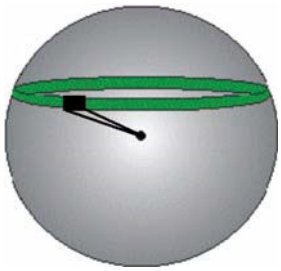


Figure 2-2: VS330's Gyro Aiding

The gyro aiding accurately smoothes the heading output and the rate of turn. It provides an accurate substitute heading for a short period depending on the roll and pitch of the vessel, ideally seeing the system through to reacquisition. The gyro provides an alternate source of heading, accurate to within 1º per minute for up to three minutes, in times of GNSS loss for either antenna. If the outage lasts longer than three minutes, the gyro will have drifted too far and the VS330 begins outputting null fields in the heading output messages. There is no user control over the timeout period of the gyro.

The gyro initializes itself at powerup and during initialization, or you can calibrate it as outlined in the Hemisphere GNSS Technical Reference Guide. For optimal performance, when the gyro is first initializing, the dynamics the gyro experiences during this warmup period are similar to the regular operating dynamics. For example, if you use the VS330 on a high speed, maneuverable craft, it is essential that when gyro aiding in the VS330 is first turned on, use it in an environment that has high dynamics for the first five to ten minutes instead of sitting stationary.

With the gyro enabled, the gyro is also used to update the post HTAU smoothed heading output from the moving base station RTK GNSS heading computation. This means that if the HTAU value is increased while gyro aiding is enabled, there will be little to no lag in heading output due to vehicle maneuvers. The Hemisphere GNSS Technical Reference Guide includes information on setting an appropriate HTAU value for the application.

Time Constants

The VS330 incorporates user-configurable time constants that can provide a degree of smoothing to the heading, pitch, rate-of-turn (ROT), course-over-ground (COG), and speed measurements. You can adjust these parameters depending on the expected dynamics of the vessel. For example, increasing the time is reasonable if the vessel is very large and is not able to turn quickly or would not pitch quickly.

The resulting values would have reduced "noise," resulting in consistent values with time. However, if the vessel is quick and nimble, increasing this value can create a lag in measurements. Formulas for determining the level of smoothing are located in the Hemisphere GNSS Technical Reference Guide. If you are unsure on how to set this value, it is best to be conservative and leave it at the default setting.

Heading Time Constant

Use the $JATT,HTAU command to adjust the level of responsiveness of the true heading measurement provided in the $GPHDT message. The default value of this constant is 0.1 seconds of smoothing when the gyro is enabled. The gyro is enabled by default, but can be disabled. By disabling the gyro, the equivalent default value of the heading time constant would be 0.5 seconds of smoothing. This is not automatic, and therefore it must be manually entered. Increasing the time constant increases the level of heading smoothing and increases lag.

Pitch Time Constant

Use the $JATT,PTAU command to adjust the level of responsiveness of the pitch measurement provided in the $PSAT,HPR message. The default value of this constant is 0.5 seconds of smoothing. Increasing the time constant increases the level of pitch smoothing and increases lag.

Rate-of-Turn (ROT) Time Constant

Use the $JATT,HRTAU command to adjust the level of responsiveness of the ROT measurement provided in the $GPROT message. The default value of this constant is 2.0 seconds of smoothing. Increasing the time constant increases the level of ROT smoothing.

Course-Over-Ground (COG) Time Constant

Use the $JATT,COGTAU command to adjust the level of responsiveness of the COG measurement provided in the $GPVTG message. The default value of this constant is 0.0 seconds of smoothing. Increasing the time constant increases the level of COG smoothing. COG is computed using only the primary GNSS antenna and its accuracy depends upon the speed of the vessel (noise is proportional to 1/speed). This value is invalid when the vessel is stationary.

Speed Time Constant

Use the $JATT,SPDTAU command to adjust the level of responsiveness of the speed measurement provided in the $GPVTG message. The default value of this parameter is 0.0 seconds of smoothing. Increasing the time constant increases the level of speed measurement smoothing.

Chapter 3: Installing the VS330

Mounting the Antennas

Mounting the Receiver

Routing and Connecting Cables

Connecting the Receiver to External Devices

Default Parameters

Installing the VS330

Mounting the Antennas

Hemisphere GNSS recommends mounting the antennas first, and then the mounting the receiver.

When mounting the antennas consider the following:

- Mounting orientation (parallel or perpendicular)
- Proper antenna placement
- Mounting options (magnetic, pole, or rail mounting)

Antenna Options

The standard VS330 kit does not include antennas. Your VS330 kit may contain a combination of the following antennas: A42, A43, A45, and/or A52. For example:

- If you **will** be using beacon, your kit may include one A43 beacon antenna and one A42 antenna (or one A43 and one A52).
- If you **will not** be using beacon, your kit may include two A42 antennas, two A45 antennas, or two A52 antennas.

Mounting Orientation

The VS330 outputs heading, pitch, and roll readings regardless of the orientation of the antennas. However, the relation of the antennas to the boat's axis determines whether you will need to enter a heading, pitch, or roll bias. The primary antenna is used for positioning and the primary and secondary antennas, working in conjunction, output heading, pitch, and roll values.

Regardless of which mounting orientation you use, the VS330 provides the ability to output the heave of the vessel. This output is available via the $GPHEV message. For more information on this message refer to the Hemisphere GNSS Technical Reference Guide.

Parallel Orientation

The most common installation is to orient the antennas parallel to, and along the centerline of, the axis of the boat. This provides a true heading. In this orientation:

- If you use a gyrocompass, you can enter a heading bias in the VS330 to calibrate the physical heading to the true heading of the vessel.
- You may need to adjust the pitch/roll output to calibrate the measurement if the Vector is not installed in a horizontal plane.

Perpendicular Orientation

You can also install the antennas so they are oriented perpendicular to the centerline of the boat's axis. In this orientation:

- You will need to enter a heading bias of +90° if the primary antenna is on the starboard side of the boat and -90° if the primary antenna is on the port side of the boat.
- You will need to configure the receiver to specify the GNSS antennas are measuring the roll axis using $JATT,ROLL,YES.
- You will need to enter a roll bias to properly output the pitch and roll values.
- You may need to adjust the pitch/roll output to calibrate the measurement if the Vector is not installed in a horizontal plane.

Planning the Optimal Antenna Placement

Note: In the VS330 kit, install the A42 or A52 antenna as the primary antenna as it is used for positioning.

Proper antenna placement is critical to positioning accuracy. For the best results, orient the antennas so the antennas' connectors face the same direction. Also, place the antennas:

- With a clear view of the horizon
- Above metal objects or other obstructions that may cause multipath
- Away from other electronics and antennas
- Along the vessel's centerline

WARNING: You must install the primary antenna along the vessel's centerline; you cannot adjust the position readings if the primary antenna is installed off the centerline. Positions are computed for the primary antenna.

Positions are computed for the primary antenna.

- On a level plane
- With a 10.0 m or 5.0 m maximum separation (default is 1.0 m)
  - With a dual-frequency activation, the maximum separation is 10.0 m
  - Without a dual-frequency activation, the maximum separation is 5.0 m
- Away from radio frequencies
- As high as possible

Set the MSEP value to be accurate to within 1 to 2 cm. For more information on MSEP refer to the Hemisphere GNSS Technical Reference Guide).

See Figure 3-1 below through Figure 3-3 for mounting orientation examples.

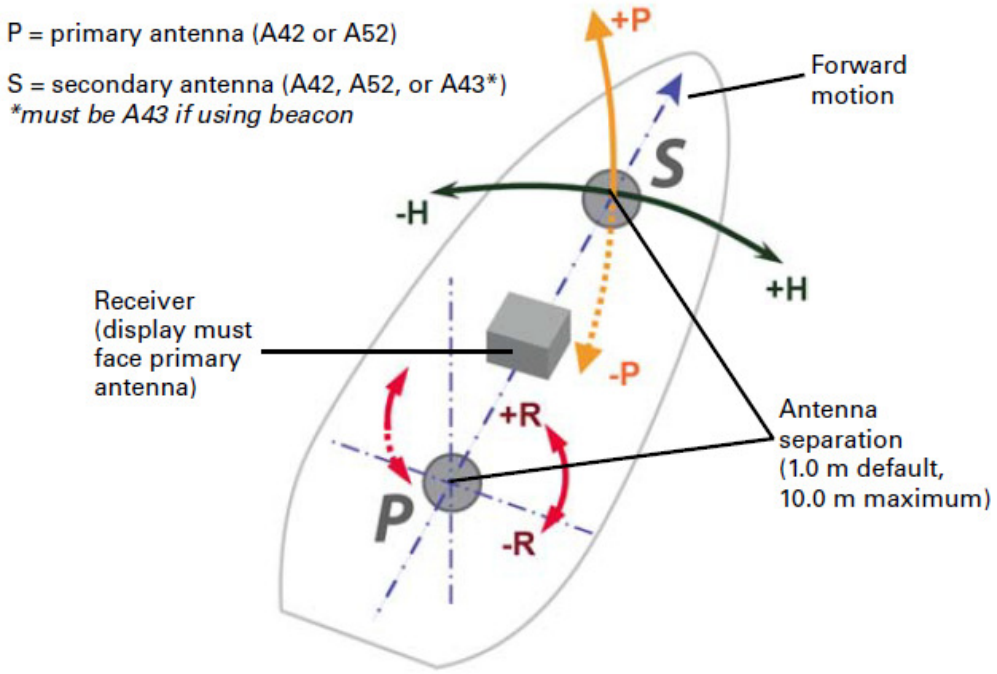


Figure 3-1: Recommended Orientation and Resulting Signs of HPR Values

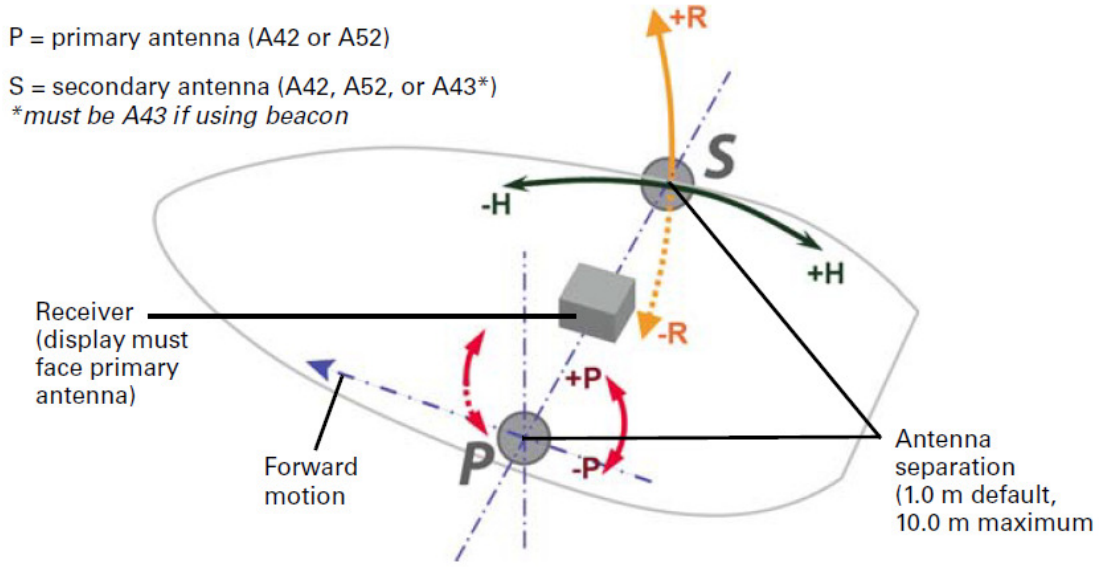


Figure 3-2: Alternate Orientation and Resulting Signs of HPR Values

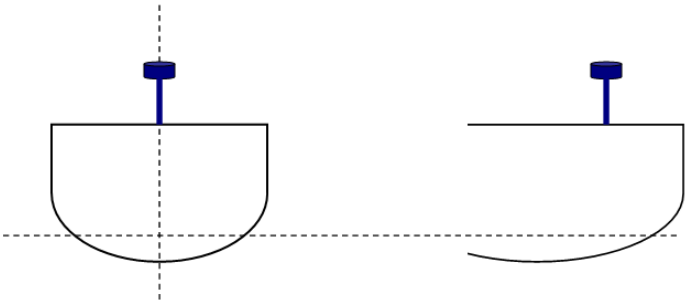


Figure 3-3: Antenna Installation: Cross-section of boat

Mounting Options

You can mount the antennas with a magnetic mount, pole mount, or rail mount configuration. You can secure the antennas to a threaded pole or threaded mount using the included mounting adapters.

Depending on the antennas included in your kit, you may need to use the included antenna height adapters to bring the antennas level. If the adapter is not used, you will need to enter a non-level bias calculation into the system (see "Q: I could not install my antennas at the same height. How do I calibrate for the height offset?" Appendix B, "FAQ.")

WARNING: The maximum allowable antenna separation is 10.0 m. Any greater distance may result in an incorrect heading.

Magnetic Mount

The following procedure assumes your kit contains one A43 beacon antenna and one A42 antenna. If your kit contains an A52 antenna instead of an A42, follow the same steps. If your kit does not contain an A43 beacon antenna, mount both antennas in the same manner as outlined in the steps for the A42.

Note: Your kit may not include a magnetic mount.

You can screw the magnetic mount into the bottom of the antenna and mount it to any metal surface. If there are no metal surfaces, use the zinc disc and foam adhesive included in your kit to mount the antenna.

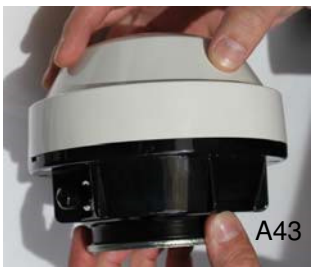
To mount the antennas using the magnetic mount:

1. Select a location and orientation that meet the requirements outlined in "Mounting Orientation" and "Planning the Optimal Antenna Placement".
2. **A42 antenna only:** Unlike the A43, the A42 antenna does not include a threaded mounting hole. You must attach the mounting bracket (see at right) using the four screws in your kit.
3. Attach the magnetic mount extension to the magnetic base plate.

Note: Photos at right and in step 4 show the zinc disc attached to the magnetic base plate. You will only need the zinc disc if mounting the antenna to a non-metal surface (see steps 6 through 9).

4. Thread the magnetic mount into the mounting bracket on the bottom of the A42 or A52 antenna or into the bottom of the A43 antenna.

WARNING: When threading the magnetic mounts, hand tighten only. Damage resulting from over-tightening may void your warranty.



If you are mounting the antenna on a metal surface, go to step 5.

If you are mounting the antenna on a non-metal surface and need to use the metal disc and foam adhesive, skip step 5 and complete steps 6 through 9.

5. Place the antenna in the desired location, ensuring the antenna is secure in its mounting position (end of metal surface mounting procedure).
6. Clean and dry the surface where you will attach the zinc disc.
7. Remove the backing from one side of the foam adhesive and press the adhesive onto the zinc plate (at right).
8. Remove the backing from the other side of the foam adhesive and press the zinc disc onto the mounting surface on the vessel, applying firm pressure to ensure good adhesion.
9. Place the antenna on top of the zinc disc, ensuring the antenna is secure in its mounting position.

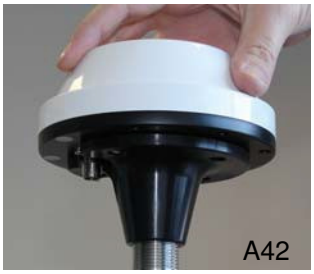
Pole Mount

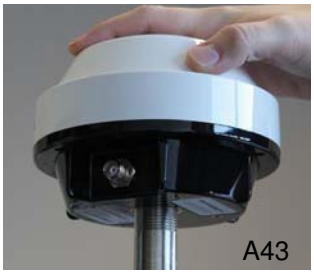
The following procedure assumes your kit contains one A43 beacon antenna and one A42 antenna. If your kit contains an A52 antenna instead of an A42, follow the same steps. If your kit does not contain an A43 beacon antenna, mount both antennas in the same manner as outlined in the steps for the A42.

You can pole-mount the antennas using existing hardware on your vessel.

To mount the antennas using a pole mount:

1. Select a location and orientation that meet the requirements outlined in "Mounting Orientation" and "Planning the Optimal Antenna Placement".
2. **A42 antenna only:** Unlike the A43, the A42 antenna does not include a threaded mounting hole. You must attach the mounting base using the four screws included in your kit (see at right).
3. Thread the pole mount (not included) into the mounting bracket on the bottom of the A42 antenna or into the bottom of the A43 antenna.


A42


A43

WARNING: When threading the pole mounts, hand tighten only. Damage resulting from over-tightening may void your warranty.

4. Mark and drill any mounting holes necessary for the pole mounts.

Rail Mount

You can rail mount the antennas using existing hardware on your vessel.

To rail mount the antennas:

1. Select a location and orientation that meet the requirements listed in "Mounting Orientation" and "Planning the Optimal Antenna Placement".
2. Use appropriate hardware to securely attach the antenna to the railing.

Routing and Securing the Antenna Cable

WARNING: The VS330 receiver provides 5 VDC across the antenna ports. Connection to incompatible devices may damage equipment.

To route and secure the antenna cables, review the following guidelines. Each antenna in your kit requires a 50 Ω impedance antenna extension cable, such as RG-58U (up to a maximum of 15 m (49 ft.) in length), for proper operation.

- The GNSS receiver inside the VS330 requires a minimum input gain of 10 dB (and maximum of 40 dB before saturation will occur). The antennas offer 28 dB of gain, so the loss budget to accommodate for cable losses is 18 dB.
- Regardless of the cable material and length you choose, ensure the cable losses are less than 18 dB of attenuation. Due to variances in the antenna gain and practical attenuation of cable materials and connectors, Hemisphere GNSS recommends reducing this budget to 15 dB; this budget is present to overcome the resulting attenuation of an RF cable.
- When deciding on an antenna location, consider the amount of cable required: A longer cable of the same material will result in a higher loss than a shorter one. If the overall loss of the longer cable exceeds 15 dB, change the cable material (this normally means a more expensive material that has a larger diameter and less flexibility). The standard cables included with the VS330 are of the RG58 material family and their attenuation is ~0.8 dB/m. Including connector losses, the nominal loss of these RF cables is ~10 dB, which is within the tolerable loss budget. If a 15 m or 20 m cable run is required, sophisticated materials are required.

For more information on cable length or low-loss cable, contact your dealer or Hemisphere GNSS Technical Support. Table 3-1 provides a summary of readily available cable materials with 50 Ω impedance.

Table 3-1: Cable losses (not including connector losses)

Material	Loss at GPS L1 (1.575 GHz)
RG58	0.78 dB/m
RG8	0.36 dB/m
Times Microwave LMR400	0.15 dB/m

For additional cable guidelines see "Routing and Connecting the Cables".

Mounting the Receiver

Hemisphere GNSS recommends mounting the antennas first and then the mounting the receiver. Use the enclosed kit to mount the receiver. When mounting the VS330 receiver, adhere to the following guidelines:

- Install the receiver inside and away from the elements in a location that minimizes vibration, shock, extreme temperatures, and moisture
- Position the receiver horizontally with its display facing the primary antenna
- Ensure the front panel (menu screen, LEDs, buttons) is visible and accessible
- Ensure the back panel (ports, connectors) is easily accessible to connect/ switch out cables

Figure 3-4 shows the dimensions (including attached mounting brackets) of the VS330. Refer to Figure 3-4 when following the receiver mounting procedure.

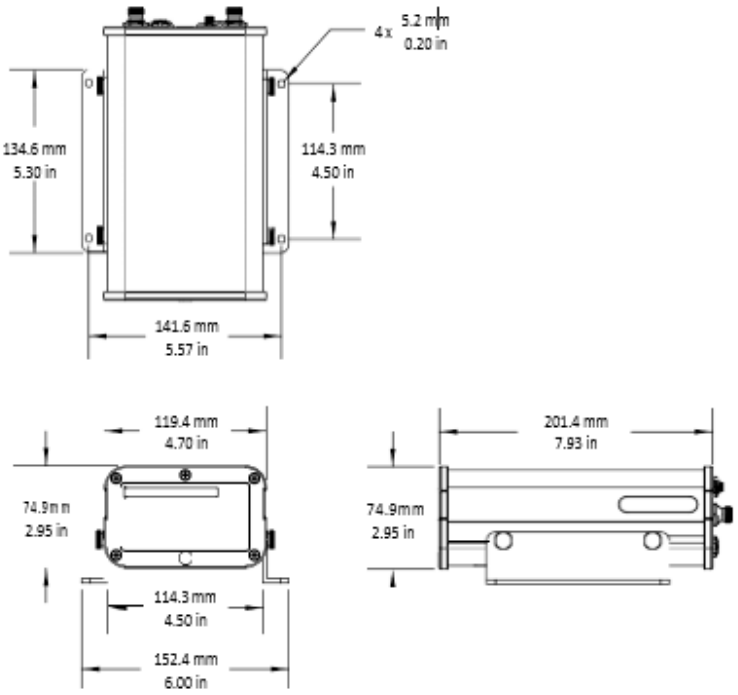


Figure 3-4: VS330 Dimensions with Mounting Brackets

To mount the receiver:

1. Locate the thumbscrews, nuts, and brackets included in your kit.
2. Slide the nuts through the opening (circled at right) along both sides of the receiver.

3. Place the bracket alongside the receiver and insert the thumbscrews (two thumbscrews per bracket) so they screw into the nuts.

4. Using the remaining holes in the brackets (two holes per bracket) screw down the brackets in your preferred location.

Note: HGNSS does not provide the screws for this step.

Routing and Connecting the Cables

Adhere to the following when routing and connecting cables:

Do…	Do Not…
Ensure your power cable can reach an appropriate power source	Run cable in areas of excessive heat
Ensure antenna cables can reach from the antennas to the receiver	Expose cable to corrosive chemicals
Use your data cable to connect to a data storage device, computer, or other device that accepts GNSS data	Crimp or excessively bend cable
Coil up excess cable near unit	Place tension on cable
Secure along the cable route using plastic tie wraps as necessary	Run cable near high voltage or strong RF noise and transmitter sources
Ensure the power source is between 8 V and 36 V when connecting the power cable to the power source	

WARNING: Improperly installed cables near machinery can be dangerous.

Connecting the Receiver to External Devices

You can connect the VS330 to external devices via Port A and Port B on the back of the unit.

Figure 3-5: VS330 Port Connections

Figure 3-6 shows the pinout for Port A (ODU 9-pin) and Port B (DB9), and Table 3-2 provides descriptions of the pinouts for each port. Both ports communicate at the RS-232 interface level with external data loggers, navigation systems, and other devices, while Port A can also transmit at the RS-422 level.

The default baud rates, NMEA message types, and update rates for both ports are listed in "Default Parameters". If the NMEA data messages you desire are different from the default values, you will need to select those also. Use the Config Wizard to select your NMEA message types and update rates per port (see "Using the Config Wizard").

Table 3-2: Port A/Port B Pinout descriptions

Pin	Port A	Port B
1	Port A Rx (RS-232)	Not connected
2	Signal ground	Port B Tx (RS-232)
3	Signal ground	Port B Rx (RS-232)
4	1 PPS timing output	Not connected
5	Port A Tx+ (RS-422)	Signal ground
6	Port A Tx- (RS-422)	Not connected
7	Event marker input	Not connected
8	Port A Tx (RS-232)	Not connected
9	Reserved	5V output, 350 mA max

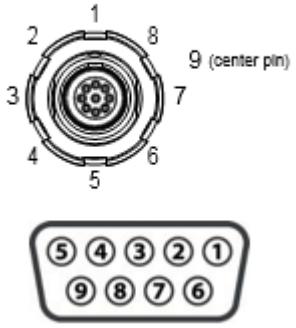


Figure 3-6: Port A (top) and Port B (bottom) Pinouts

Figure 3-7 shows the I/O cable that connects to Port A.

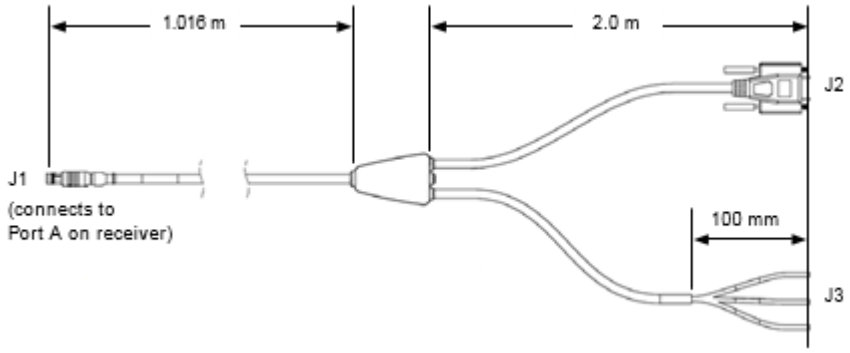


Figure 3-7: I/O cable

Default Parameters

The following represents the standard configuration for the VS330. For more information on these commands refer to the Hemisphere GNSS Technical Reference Guide.

Note: Use the $JSAVE command to save changes you make to the VS330 configuration for the changes to be present in subsequent power cycles. If you change any default values and issue a $JRESET command, verify your settings to ensure you consistently get a correct heading.
To reset the VS330 to its default parameters, you can re-install the configuration file (shown below)—contact your dealer or Hemisphere GNSS Technical Support for information on obtaining and re-installing the configuration file.

Table 3-3: Default Parameters

Setting	Parameter	Description
Elevation Mask:	10	10 Degree Elevation Mask
RTK Timeout	2700s	RTK correction will be dropped after 2700s
Decimal Precision	5	Decimal values in NMEA messages will have 5 digits of precision
Diff Source:	SBAS	SBAS will be used
COG TAU	0	See Time Constants
Speed TAU	0	See Time Constants
HTAU	0.1	See Time Constants
HRTAU	2.0	See Time Constants
MSEP	1	This is the measured separation (in meters) between the primary and secondary antennas. This value should be precisely measured (within 2cm) and entered into the receiver. The default value is 1m. The minimum value is **0.5m** and the maximum value is **10.0m** if the VS330 has a dual frequency activation and **5.0m** if the VS330 does not have a dual frequency activation
GYROAID	YES	The internal gyro is enabled by default. This provides two benefits: 1) It shortens reacquisition times when a GPS heading is lost because of obstruction of satellite signals. It does this by reducing the search volume required for solution of the RTK. 2) It provides an accurate substitute heading for a short period (depending on the roll and pitch of the vessel) ideally seeing the system through to reacquisition.
TILTAID	YES	The sensors act to reduce the RTK search volume, which improves heading startup and reacquisition times. This improves the reliability and accuracy of selecting the correct heading solution by eliminating other possible, erroneous solutions.
HBIAS	0	0 degrees will be added to offset heading value
Port A Baud	19200	
Port A NMEA		GGA 1Hz, HDT 10Hz ROT 10Hz HPR 1Hz
Port B Baud	19200	
Port B NMEA		GGA 1Hz, HDT 10Hz ROT 10Hz HPR 1Hz

For a complete list of messages, refer to the Hemisphere GNSS Technical Reference Guide.

Chapter 4: Operating the VS330

Operating the V330

Powering the Receiver On/Off

The power button on the VS330 is located on the front panel (circled below). When you first apply power to the unit it turns on.

Figure 4-1: VS330 Front Panel with Power Button

The VS330 accepts an input voltage of 8 to 36 VDC via the power cable. The supplied power should be continuous and clean for best performance. Table D-5 provides the power specifications of the VS330.

WARNING: Do not apply a voltage higher than 36 VDC. This will damage the receiver and void the warranty. Also, do not attempt to operate the VS330 with the fuse bypassed as this will void the warranty.

The VS330 features reverse polarity protection to prevent damage if the power leads are accidentally reversed. Although the VS330 proceeds through an internal startup sequence when you apply power, it will be ready to communicate immediately.

Initial startup may take 5 to 15 minutes depending on the location. Subsequent startups will output a valid position within 1 to 5 minutes depending on the location and time since the last startup.

The VS330 may take up to 5 minutes to receive a full ionospheric map from SBAS. Optimum accuracy is obtained once the VS330 is processing corrected positions using complete ionospheric information.

To power on the VS330:

1. Connect the ends of the VS330 power cable to a clean power source providing 8 to 36 VDC.

   Note: Hemisphere GNSS recommends you use a weather-tight connection and connector if the connection is located outside.

2. Press and hold the soft power switch on the front panel until the splash screen appears.

To power off the VS330:

1. Press and hold the soft power switch on the front panel until the screen goes blank.

LED Indicators

The VS330 includes five LEDs located to the left of the display on the front panel (shown at right).

Figure 4-2: VS330 LEDs

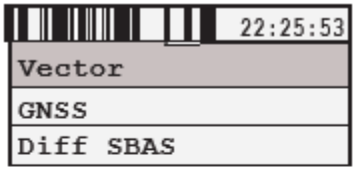
Table 4-1 below describes each LED indicator.

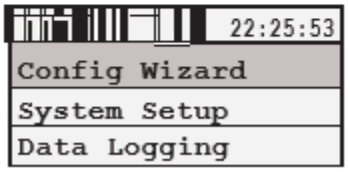
Table 4-1: LED indicators

Indicator	Description/Function
HEADING	• Valid GNSS heading available • Illuminates solid green when the receiver achieves a valid heading solution from the GNSS receiver. You must see PRIM GNSS and SEC GNSS illuminated before a heading solution is possible. • If the GNSS solution is no longer available, the LED powers off.
DIFF	• DGNSS position indicator • Illuminates solid green when the receiver achieves a differential position and a pseudorange residual of better than 10.0 m. • If the residual value is worse than the current threshold, the LED blinks green indicating differential mode has been attained but the residual has not met the threshold.
SEC GNSS	• Secondary antenna is tracking 4 or more satellites • Illuminates solid amber when the secondary antenna is tracking four or more satellites.
PRIM GNSS	• Primary antenna is tracking 4 or more satellites • Illuminates solid amber when the primary antenna is tracking four or more satellites.
POWER	• Power indicator • Illuminates solid red when the receiver is powered-on.

Startup

When you power on the VS330 the Hemisphere GNSS splash screen appears followed by the main screen, or Top menu (see at top right). Press the Down Arrow button to display the remaining items on the Top menu (see at bottom right).





You use the menus to view and configure system data and settings for the following Top menu items:

- Vector
- GNSS
- Differential (menu item will be the selected differential source, such as SBAS or Autonomous)
- Config Wizard
- System Setup
- Data Logging

For a complete menu path of each Top menu item, see Appendix C, Menu Map.

Using the Menus

The VS330 menu system is designed for easy setup and configuration of the unit in or out of the field and supports multiple languages. You can perform most configuration tasks entirely through the menu without having to connect to a computer.

The VS330 front panel contains the three soft buttons shown at right. The Enter button also functions as the power switch (see "Powering the Receiver On/Off" for more information).

Up Arrow button - moves to the previous menu item or to the previous selection within a menu item

Enter button - displays a submenu or selects an option within a menu item

Down Arrow button - moves to the next menu item or to the next selection within a menu item

Table 4-2 describes the indicators to the right of specific menu items.

Table 4-2: Menu item indicators

Indicator	Purpose	Example
 Display indicator	Goes to the indicated submenu. This indicator also appears to the right of the "Back" and "Top Menu" menu items. • Press Enter when "Back" is selected to return to the previous menu. • Press Enter when "Top Menu" is selected to return to the Top menu.	1. On the Top menu press the **Down Arrow** button to highlight System Setup. The Display indicator appears to the right of System Setup. 2. Press **Enter** to display the System Setup menu. 3. Press the **Down Arrow** button again to highlight the Display Format option and then press **Enter**. The items on the Display Format menu appear and the Select indicator appears to the right of Disp Update (the first item on the Display Format menu). 4. Press **Enter** on the Disp Update item. The Display indicator changes to the Select indicator. 5. Press the **Up Arrow** or **Down Arrow** button to scroll through the available options (such as 1Hz and 5Hz). 6. Press **Enter** on the highlighted option to select it. That option is now the setting for the menu item and the Select indicator changes back to the Display indicator.
 Select indicator	Scrolls within a menu to highlight an option to select.	

To return the menu system to the factory default configuration:

- Press and hold the **Enter** and **Up Arrow** buttons until the splash screen disappears (Enter and Power share the same soft switch).

Configuring the VS330

The Config Wizard menu guides you through various configuration options, enabling you to save up to five different configurations that are useful when using the VS330 on different vessels or for different applications.

Config Wizard Menu

This section describes the basic Config Wizard options you need to set to get up and running. Figure 4-3 outlines the menu structure of the Config Wizard menu.

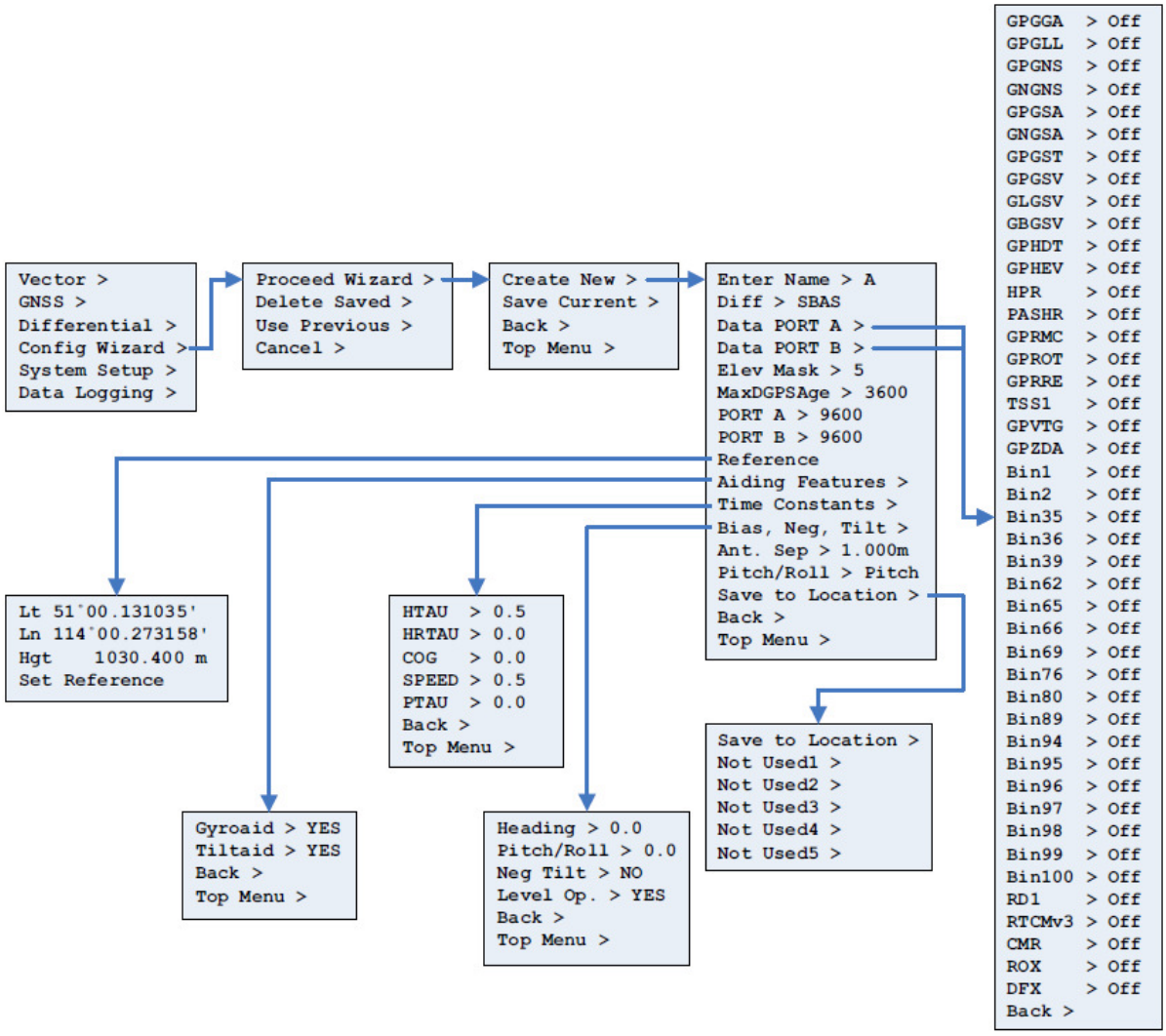


Figure 4-3: Config Wizard Menu

Using the Config Wizard

The basic setup instructions outlined in this section assume the antennas are:

- Installed parallel to, and along the centerline of, the vessel's axis
- Separated by 1.0 m

If this is not the case, you will need to enter the actual antenna separation and bias in the Config Wizard.

1. Select **Config Wizard > Proceed Wizard**. The Proceed Wizard menu appears.
2. *Select **Create New** to create a new configuration.* You are prompted to enter a name for your configuration. In addition to the Name you can set the options shown at right (also shown in Figure 4-3 on the previous page).

Note: For help on using the menus to view and setting values see "Using the Menus".

3. *Enter a name:*
   a. Use the arrow buttons to select a character and then press the **Enter** button to save the character. The cursor moves to the right.
   b. Repeat step a for each additional character in the name.
   c. Scroll through the list of characters until you reach and press the **Enter** button to accept the name. You are returned to the previous menu and the name you entered appears next to "Enter Name."

```
Enter Name > A
Diff > SBAS
Data PORT A >
Data PORT B >
Elev Mask > 5
MaxDGPSAge > 3600
PORT A > 9600
PORT B > 9600
Reference
Aiding Features >
Time Constants >
Bias, Neg, Tilt >
Ant. Sep > 1.000m
Pitch/Roll > Pitch
Save to Location >
Back >
Top Menu >
```

If you are editing an existing name, for characters you want to replace simply select a different character. If the new name is shorter and you need to delete unneeded characters to the right:

a. After you change the final character in the new name press the **Enter** button repeatedly until the last character is highlighted.
b. Scroll through the list of characters until you reach "◄" and press the **Enter** button to delete the character. The cursor moves to the left.
c. Repeat step b for each additional rightmost character you want to delete.
d. Scroll through the list of characters until you reach "↵" and press the **Enter** button to accept the name. You are returned to the previous menu and the name you entered appears next to "Enter Name."

4. *Set a DGNSS source:* From the same menu, select DIFF.
   The options are:
   - SBAS (default)
   - Beacon Autonomous RTK
   - L-band
   - Extern RTCM (External RTCM)

5. *Change the type of GNSS data message sent to the data ports:* Select either **Data Port A** or **Data Port B** from the menu list.
6. *Set the elevation cutoff angle:* Select **Elev Mask** and set the angle between 0° and 45°. The default value is 5°.
7. *Set the maximum DGNSS age:* The maximum DGNSS age is 2700 seconds (45 minutes) by default.
8. *Configure baud rates:* If the default baud rate on the selected port does not match that of the external device you are connecting to, you will need to configure the Baud Rate, using the Port A or Port B entries.

   4800, 9600, 19200, 38400, 57600, and 115200 are the available baud rates.

9. *Enable/disable aiding features:* The Aiding Features menu enables you to turn the gyroaid and tiltaid features on or off. For more information on disabling the aiding features, see "Disabling Tilt Aiding" or "Disabling Gyro Aiding".
10. *Adjust time constants:* While the default time constants settings will work for most users, if you have a large, slow turning vessel or a small, quick-moving, vessel you may want to adjust the time constants to reduce heading start up and re acquisition times.

For details on configuring the time constants, see "Adjusting the Time Constants".

11. *Enter a heading bias:* If you did not install the antenna's parallel to and along the vessel's centerline, you will need to enter a heading bias in the Heading field of the Bias, Neg, Tilt menu. The heading bias (-180º to +180°) compensates for any offset from the centerline.

    Note: If you installed the antennas for roll (perpendicular to the boat's axis), rather than pitch, you must enter the heading bias (+/-90°). You must also enter the bias for roll (see below).

12. *Enter a pitch/roll bias:* Enter the bias for pitch or roll (-15° - +15°) to compensate for any offset from the boat's centerline. Enter this bias in the Pitch/Roll field of the Bias, Neg, Tilt menu.
13. *Enter the antenna separation:* If you did not install the antennas 1.0 m apart, enter the actual antenna separation In the Ant. Sep field. The available range is 0 - 10.0 m.
14. *Configure antenna for roll:* Most users install the antennas for pitch; however, if you install the antennas for roll, you will need to configure the VS330 for roll. In the Create New menu set the Pitch/Roll setting to Roll.
15. *Save your configuration:* To save your new configuration, select the Save to Location field. You will be prompted for a location to save your configuration.

Select one of the empty slots, noted by the name Not Used or select a slot with an existing configuration to overwrite it.

After your configuration is saved, you must select it from the Config Wizard in order to activate it. You may then continue to enter different receiver configurations without upsetting the current operation of the receiver. Re- enter the Config Wizard and select the configuration to use.

Disabling the Aiding Features

While the default settings will work for most users, you can configure the tilt and gyro aiding features to further reduce heading startup and re-acquisition times.

Disabling Tilt Aiding

The VS330's tiltaid (accelerometer) is enabled by default and constrains the RTK heading solution to reduce startup and re acquisition times. The tiltaid is pre-calibrated at the factory; however, if you experience any tilt measurement offset, you can recalibrate the tilt sensor via the Calibrate Tilt option in the Vector menu. See Vector menu for a menu map on how to access this feature.

Note: Make sure the receiver is perfectly level before recalibrating the tiltaid.

The only times you may need to disable the tiltaid feature are:

- If you were unable to install the VS330 on a level plane with the antennas. The tilt sensor is located inside the VS330, so it is important that you install the VS330 on a level horizontal plane.

WARNING: If you were unable to install the VS330 in a horizontal plane with the antennas, you must disable tiltaid. Failure to do so may cause erratic equipment behavior.

- If troubleshooting, to ensure the receiver is working properly.

You can turn tilt aiding off either through the Config Wizard or Vector menus.

Disabling Gyro Aiding

The VS330's internal gyro-aid is enabled by default. The gyro:

- Shortens re-acquisition times when satellites are obstructed and heading is lost, by reducing the search volume required for the RTK solution, and
- Provides accurate substitute headings for a short period (depending on the roll and pitch of the vessel) ideally seeing you through to re-acquisition.

The only time you might need to disable the gyro-aid is during troubleshooting, to ensure the receiver is working properly.

WARNING: Do not exceed turn rates of 90º/sec. The VS330 uses gyro measurements to obtain a heading rate measurement and the gyro cannot measure beyond this rate.

You can turn the gyroaid feature off either through the Config Wizard menu or the Vector menu.

Adjusting the Time Constants

The VS330's default settings are acceptable for most users; however, you can set the time constants to further smooth heading, course-over-ground (COG), and speed measurements. Table 4-3 provides an overview of the time constant values you can set in the Config Wizard, including the formulas for finding the optimal value of each time constant for your vessel.

Table 4-3: Time Constants

Time Constant	Description
COGTAU (Course Over Ground)	Adjust the responsiveness to the course over ground measurement. If vessel is small and dynamic, leave this value at 0.0 s to be conservative. If the vessel is large and resistant to motion, you may want to increase this value. Default value: 0.0 s Range: 0.0 to 60 s Formula: cogtau (s) = 10 / max rate of change of course ($^{\circ}$/sec)
HRTAU (Rate of Turn)	Adjust the responsiveness to the rate of heading change. If vessel is large and unable to turn quickly, you may want to increase this value. Default value: 2.0 s with gyro enabled Range: 0.0 to 60 s Formula: hrtau (s) = 10 / max rate of the rate of turn ($^{\circ}$/s^2)
HTAU (Heading)	Adjust the responsiveness to true heading. If vessel is large and unable to turn quickly, you may want to increase this value. For longer baselines (10 m) HTAU should be between 0.1 and 0.5, since the gyro introduces noise. Default value: 0.1 s with gyro enabled Range: 0.0 to 60 s Formula: htau (s) = 40 / max rate of turn ($^{\circ}$/s) *with gyro ON* htau (s) = 10 / max rate of turn ($^{\circ}$/s) *with gyro OFF*
PTAU (Pitch)	Adjust the responsiveness to pitch. If vessel is large and unable to pitch quickly, may want to increase this value. Default value: 0.5 s Range: 0.0 to 60 s Formula: ptau (s) = 10 / max rate of pitch ($^{\circ}$/s)
SPDTAU (Speed)	Adjust the responsiveness to speed. If vessel is small and dynamic, leave this value at 0.0 s to be conservative. If the vessel is large and resistant to motion, you may want to increase this value. Default value: 0.0 s Range: 0.0 to 60 s Formula: spdtau (s) = 10 / max acceleration (m/s^2)

Connecting to Existing Navigation Systems

Most users connect the VS330 to their existing navigation system during installation. These users will receive the VS330's position and heading updates through the interface of their existing system.

Viewing GNSS/DGNSS Status

Most users will receive position and heading information through their on-board navigation system. If you have not connected the VS330 to an existing navigation system, or are troubleshooting your unit, you may need to view GNSS, DGNSS, or beacon status on the VS330's display screen.

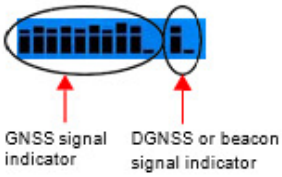
Do I Have a Signal?

Figure 4-2 shows which LEDs on the VS330 will indicate GNSS, DGNSS or Beacon signal lock when illuminated. If you lose the differential signal lock, Hemisphere GNSS TRACER™ technology allows the VS330 to perform well for 40 minutes or more with aging differential GNSS correction data. The amount of time you can "coast" depends on the degree of tolerable drift.

Note: To obtain a full set of SBAS corrections, the VS330 must receive the ionospheric map over a period of a few minutes. After this, the receiver can "coast" until the next set of corrections has been received.

How Good is the Quality of My Signal?

In addition to the LED indicators for signal lock, the VS330's display indicates signal quality. The bars along the top of the display represent the quality of the GNSS and DGNSS (or if applicable, beacon) signal.



The first group of bars shows the GNSS signal; the second group shows the DGNSS or beacon signal. Each bar represents a distinct channel and its associated signal quality. The higher the bar, the better the signal.

Note: If using autonomous or external correction mode, the DGNSS signal indicator will not appear in the display.

DGNSS (SBAS)

The differential correction (or SBAS) signal indicator reflects the quality of each satellite signal, or the bit error rate (BER). A full bar height reflects a signal lock and a BER of 0. A bar height only 2 pixels tall reflects a signal loss, or BER, of 500 or greater. Bar heights in between reflect intermediate degrees of signal quality. For example, when using WAAS two satellites are available, so two BERs are provided.

Beacon

The beacon indicator reflects the quality of the beacon signal, or the signal strength (SS) and the signal-to-noise ratio (SNR). A full bar height reflects a signal lock, SS>=35, and SNR>=24. A bar height only 2 pixels tall reflects a signal loss, or SS and SNR values of 0. Bar heights in between reflect intermediate degrees of signal quality.

If using beacon, the first bar indicates SS signal quality; the second bar indicates SNR signal quality.

USB Data Logging

When you insert a USB flash drive into the VS330, the Data Logging menu indicates you can start recording (logging data) and displays the free space on the flash drive (see Figure 4-4). When you start logging data the "Start Recording" indicator changes to "End <filename>."

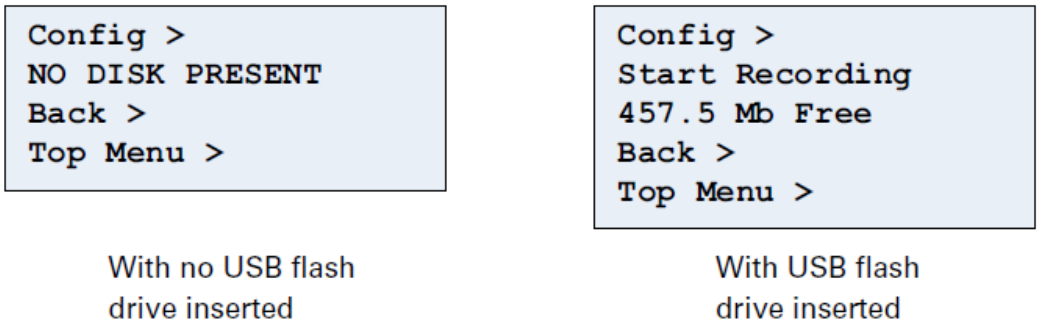


Figure 4-4: USB flash drive indicators on Data Logging menu

WARNING: Stop data logging before removing the USB flash drive from the VS330. Failure to do so may result in a loss of data.

Selecting the Data File Type and Log Options

You can log the following data types to a USB flash drive:

- RAW - binary, NMEA, and other data options (see Table 4-4)
- KML - Google Earth KML format with latitude, longitude and height
- CSV - comma-separated value (CSV) format with time, latitude, longitude, and height
- PostPro - VS330 automatically turns on the appropriate messages for post processing
- Debug - VS330 logs high speed data for troubleshooting purposes (contact Hemisphere GNSS Technical Support for more information)

Table 4-4: RAW Data Log Options

Format	Description
Raw (binary)	For raw (binary) data logging, you may also want the receiver configuration to be inserted into the file. If you select this option the file will start with the receiver configuration comprised of the replies to the $JI, $JK, $JT, and $JSHOW queries.
NMEA	National Marine Electronics Association (NMEA 0183) - industry standard data transmission format
CMR	Proprietary data correction format
DFX	Hemisphere GNSS-proprietary data correction format
ROX	Hemisphere GNSS-proprietary data correction format
RTCM	Radio Technical Commission for Maritime Services - industry standard data correction format

To select a data logging type:

1. Select Data Logging > Config > FileType.
2. Press the **Up**/**Down Arrow** buttons until your preferred data type appears then press **Enter**.

When logging using the RAW data type (File Type > RAW as shown in Figure 4-5) you can select which data to log and at what rate by selecting Data Logs and then making the desired selections on the Data Logs menu.

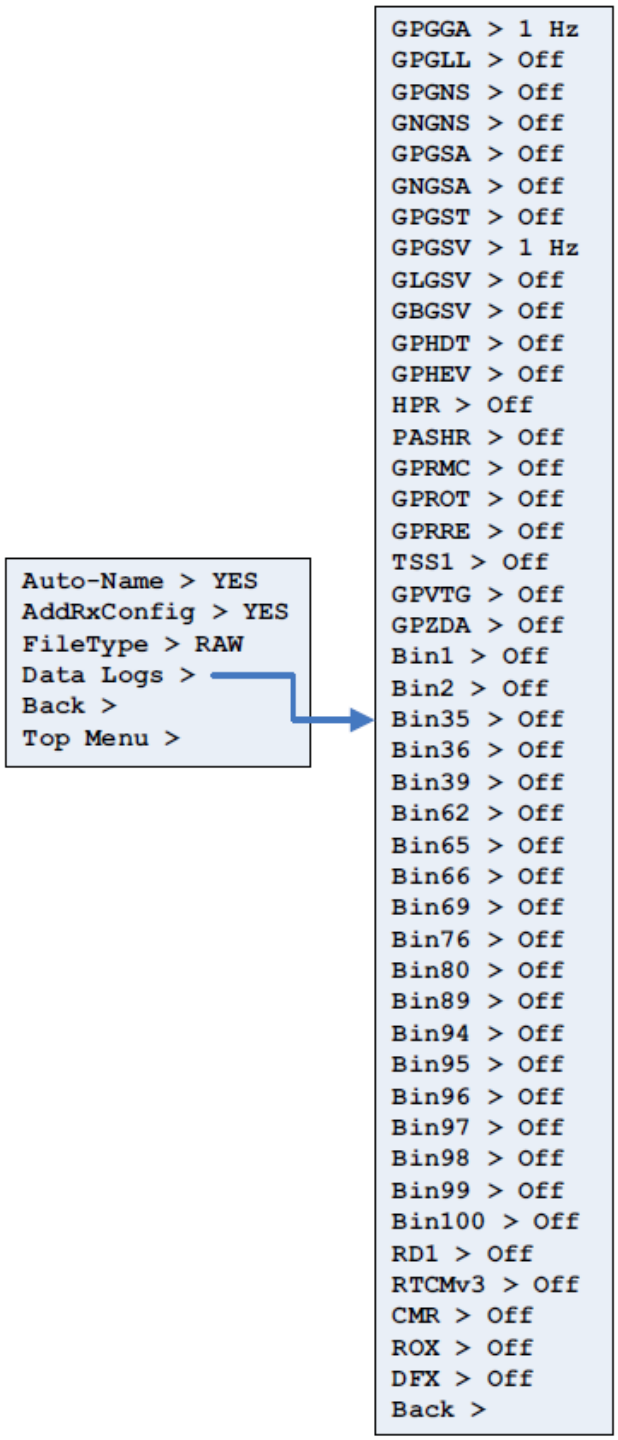


Figure 4-5: Data Logging > Config > Data Logs menu

Note: Logged data options are limited by your receiver subscriptions (certain options may not appear on the Data Logs menu without a specific subscription). For GLONASS: GNGNS, GNGSA, GLGSV, Bin62, Bin65, Bin66, and Bin69 only appear on the Data Logs menu if you are authorized to receive GLONASS. For BeiDou: GBGSV, Bin35,Bin36 and Bin39 only appear on the Data Logs menu if you are authorized to receive BeiDou.

To view your subscriptions press **System Setup > Software Disp > Authorizations**.

Logging Data to a File

You can log data to a file that the VS330 auto-generates or you can manually enter a filename to which to log data. You can append data to or overwrite data on a manually-named file; however, you cannot append data to or overwrite data on an VS330-generated file.

To log data to an VS330 auto-generate filename:

1. Select Data Logging > Config.
2. If Auto-Name displays No select **Auto-Name** and then press **Enter**.
3. Select **Yes** and then press **Enter**.
4. Select **Back** to return to the Data Logging menu.
5. Select **Start Recording** to begin logging data. The Start Recording option changes to End <filename>.
6. Select End <filename>.

To log data to a manually-created filename:

1. Select **Data Logging > Config**.
2. If Auto-Name displays Yes select **Auto-Name** and then press **Enter**.
3. Select **No** and press **Enter**. The Enter Name and Mode menu items appear below Auto-Name.
4. Enter a filename:
   a. Select **Enter Name** and press **Enter**.
   b. Enter the desired characters for the filename and then scroll to the return character and press **Enter.**
5. Select the mode:
   a. Select **Mode** and press **Enter**.
   b. Select **Append** to log data to new file or to append data to an existing file (based on the filename in step 4) and press **Enter**.

      or

   Select **Overwrite** to overwrite an existing file (based on the filename in step 4) and press **Enter**.

   WARNING: No warnings are given to confirm overwriting a previous file.

6. Select Back to return to the Data Logging menu.
7. Select Start Recording to begin logging data. The Start Recording option changes to End <filename>.
8. Select End <filename>.

Data Post-Processing

After you log data you can then process the data with a Receiver Independent Exchange (RINEX) format software utility. Hemisphere GNSS Rinex conversion software is available from the Hemisphere GNSS website .

Make sure you select PostPro as the file type before logging the data you will use for post processing (see "Selecting the Data File Type and Log Options").

To post-process raw data:

1. Log the raw data to the USB flash drive inserted in the VS330. Make sure you properly end your data logging before removing the flash drive in Step 2.
2. Remove the flash drive from the VS330 then insert the drive in a PC with Hemisphere GNSS' Rinex conversion software installed.
3. Run the Rinex conversion software.

Chapter 5: RTK

RTK

RTK Requirements

RTK provides the highest accuracy. You can set up the RTK system using the VS330.

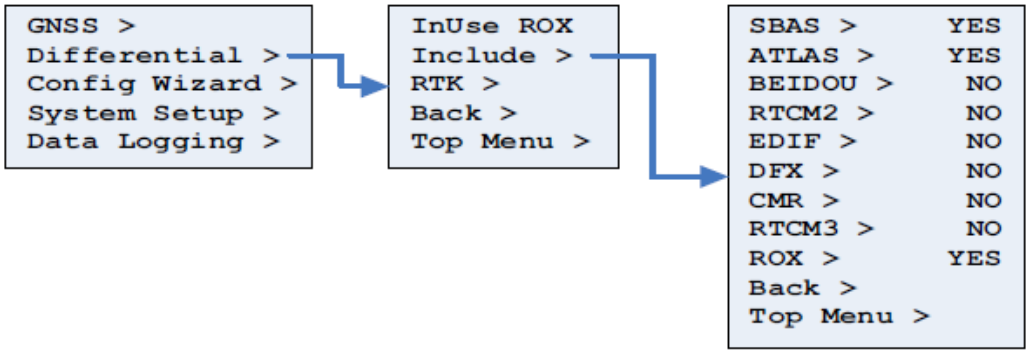
To setup RTK you will need the following:

- GNSS receiver
- GNSS antennas
- Power source

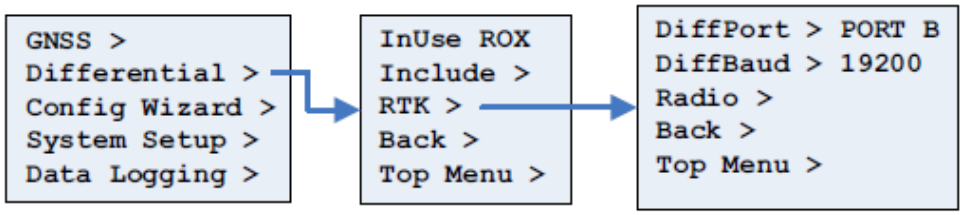
Setting Up RTK

To set up the VS330 for RTK:

1. *Select your differential corrector:* From the Top menu press **Differential > Include** then set your preferred RTK corrector to **YES** (ROX set to YES in example below). When RTK is achieved, the Differential menu shows the corrector type next to InUse and RTK below Include.



2. From the Top menu press **Differential > RTK** then set **DiffPort** to your preferred differential port and set **DiffBaud** to your preferred baud rate (PORT B and 19200, respectively, in example below).



RTK Operation

After you set up your RTK system, the status LEDs indicated in Table 5-1 show the progress levels of RTK:

Table 5-1: RTK LED indicators

LED	Function	LED Color	Description
	Power	Red	Illuminates solid red when the receiver is powered on.
	Primary GPS Lock	Yellow	Illuminates solid yellow when the receiver achieves a solid GNSS lock.
	Secondary GPS Lock	Yellow	Illuminates solid yellow when the receiver achieves a solid GNSS lock.
	Differential Tracking / RTK Lock	Green	If the residual value is worse than the current threshold, the LED blinks green indicating differential mode has been attained but the residual has not met the threshold. Illuminates solid green when the receiver achieves RTK position lock.

The VS330 will output standard NMEA messages through Port A or Port B. Set the message and port output as preferred (see "Config Wizard Menu" for more information on message output).

Appendix A: Troubleshooting

Appendix A: Troubleshooting

Table A-1 provides troubleshooting for common problems.

Table A-1: Troubleshooting

Symptom	Possible Solution
Receiver fails to power	• Verify polarity of power leads • Check integrity of power cable connectors • Check power input voltage (8 to 36 VDC) • Check current restrictions imposed by power source (minimum available should be > 1.0 A)
No data from VS330	• Check receiver power status to ensure the receiver is powered (an ammeter can be used for this) • Verify desired messages are activated (using $JSHOW in any terminal program) • Ensure the baud rate of the VS330 matches that of the receiving device • Check integrity and connectivity of power and data cable connections
Random data from VS330	• Verify the RTCM or binary messages are not being output accidentally (send a $JSHOW command) • Ensure the baud rate of the VS330 matches that of the remote device • Potentially, the volume of data requested to be output by the VS330 could be higher than the current baud rate supports (try using 19200 as the baud rate for all devices or reduce the amount of data being output)
No GNSS lock	• Verify the VS330 has a clear view of the sky • Verify the lock status of GNSS satellites
No beacon lock	• Verify the receiver is tuned to the correct frequency and bit rate • Ensure beacon signal coverage is expected in your area • Ensure environmental noise is not masking the signal, reducing the SNR reading
No SBAS lock	• Verify the VS330 has a clear view of the sky • Verify the lock status of SBAS satellites (this can be done with VectorPC - monitor BER value) • Set SBAS mode to automatic with the $JWAASPRN,AUTO command SBAS lock is only possible if you are in an appropriate SBAS region; currently, there is limited SBAS availability in the southern hemisphere.

Table A-1: Troubleshooting (*continued)*

Symptom	Possible Solution
No heading or incorrect heading value	• Check CSEP value is fairly constant without varying more than 1 cm (0.39 in)—larger variations may indicate a high multipath environment and require moving the receiver location The standard antenna mounting configuration provides a 0.5° heading accuracy at 95% confidence. If you require more performance, you will need to increase the antenna separation (maximum recommended separation is 10.0 m). See Table D-1 for antenna separation specifications. • Re-calibrate the tilt sensor with $JATT,TILTCAL command if heading is calculated then lost at consistent time intervals • Heading is from primary GNSS antenna to secondary GNSS antenna • $JATT,SEARCH command forces the VS330 to acquire a new heading solution (unless gyro is enabled) • Enable GYROAID to provide heading for up to three minutes during GNSS signal loss • Enable TILTAID to reduce heading search times • Monitor the number of satellites and SNR values for both antennas within VectorPC—at least four satellites should have strong SNR values • Potentially, the volume of data requested to be output by the VS330 could be higher than the current baud rate supports (try using 19200 as the baud rate for all devices or reduce the amount of data being output)
No RTK Position	• Verify the baud rate of the RTCM input port matches the baud rate of the external source • Verify the pinout between the RTCM source and the RTCM input port (transmit from the source must go to receive of the RTCM input port and grounds must be connected) • Ensure corrections are being transmitted to the correct port—using the $JDIFF,PORTB command on Port A will cause the receiver to expect the corrections to be input through Port B

Appendix B: Frequently Asked Questions

Appendix B: Frequently Asked Questions

This appendix covers power, communication and external RTCM questions.

Q: Can COAST technology work with corrections from an external source?

A: Yes, the VS330 will operate in a similar fashion with COAST technology as when using SBAS or Beacon corrections. However, SBAS corrections have the advantage that they are separated into separate error components, allowing the VS330 to anticipate how errors will change over the coasting period with more consistent accuracy and for a longer period than regular RTCM range corrections.

Q: My VS330 does not appear to be communicating. What do I do?

A: This could be one of the following issues:

- Examine the power cable and its connector for signs of damage.
- Ensure you are properly powering the system with the correct voltage (8 to 36 VDC) by measuring the voltage at the receiver end of the power cable when the cable is connected to the power source.
- Check current restrictions imposed by power source (minimum available should be > 1.0 A).
- Verify the display has turned on and that time is incrementing in the upper right corner of the display, and configure the COM port baud rates appropriately through the menu system.
- Verify polarity of power leads.
- Check the 1.0 A inline power cable fuse.
- Since you are required to terminate the power input with your choice of connector, ensure you have made a good connection to the power supply.

Consult the troubleshooting section of the other device's reference manual to determine if there is an issue with that device.

Q: Am I able to configure the two serial ports with different baud rates?

A: Yes, the ports are independent. For example, you may have one port set to 4800 and the other to 19200 or vice versa.

Q: Am I able to have the VS330 output different NMEA messages through the two ports?

A: Yes, you may have different NMEA messages turned on for the two serial ports. Further, these NMEA messages may also be at different update rates.

Q: How do I determine the current configuration of the VS330?

A: You can view the current configuration from various screens of the menu, which show all configurable items of the receiver. Alternately, you can select **Config Wizard> Use Previous** to return the receiver to a previously saved (known) configuration.

Q: My VS330 does not appear to be using corrections from an external correction source. What could be the problem?

A: This could be due to a number of issues. Check the following items:

- Make sure the corrections are of an RTCM SC-104 protocol.
- Verify the baud rates of the port used by the VS330 match that of the external correction source.
- The external correction source should be using an 8-data bit, no parity, 1 stop bit (8-N-1) serial port configuration.
- Inspect the cable connection to ensure there are no signs of damage.
- Check the pinout information for the cables to ensure the transmit line of the external correction source is connected to the receive line of the VS330's serial port and that the signal grounds are connected.

Save the configuration as the profile named "RTCM" in the Config Wizard, cycle the power and load the RTCM profile.

Q: Why am I not getting data from the VS330?

A: There are several possible reasons for this. Check the following items.

- Check receiver power status LED to ensure the receiver is powered.
- Verify the VS330 is locked to a valid DGNSS signal (this can often be done on the receiving device or with VectorPC).
- Verify the VS330 is locked to GNSS satellites (this can often be done on the receiving device or with PocketMax).
- Check the integrity and connectivity of power and data cable connections.

Q: Why am I getting random data from VS330?

A: There are three possible reasons for this. Check the following items.

- Verify the RTCM or the Bin95 and Bin96 messages are not being output accidentally (send a $JSHOW command).
- Verify the baud rate settings of VS330 and remote device match correctly.
- Potentially, the volume of data requested to be output by the VS330 could be higher than the current baud rate supports. Try increasing the baud rate to 38400 for all devices or reduce the amount of data being output.

Q: I could not install my antennas at the same height. How do I calibrate for the height offset?

A: You may enter a non-level bias calculation that adjusts the pitch/roll output to calibrate the measurement if the antenna array is not installed on a horizontal plane.

To calibrate the pitch/roll reading, send the following command:

$JATT,PBIAS,x<CR><LF>

where x is a bias (in degrees) that will be added to the pitch/roll measurement. The acceptable pitch bias range is -15.0º to 15.0º (default is 0.0º).

To determine the current pitch compensation angle, send the following command:

$JATT,PBIAS<CR><LF>

The pitch/roll bias is added after the negation of the pitch/roll measurement (if so invoked with the $JATT,NEGTILT command).

Appendix C: Menu Map

Appendix C: Menu Map

This appendix shows the complete menu map for each menu (listed below) on the VS330 Top menu:

- Vector
- GNSS
- Differential (menu item will be the selected differential source, such as SBAS or Autonomous)
- Config Wizard
- System Setup
- Data Logging

Vector Menu

Use the Vector menu to view and adjust Vector settings. Options vary depending on whether you select Pitch or Roll and include such items as aiding features, time constants, heading bias, and antenna separation.

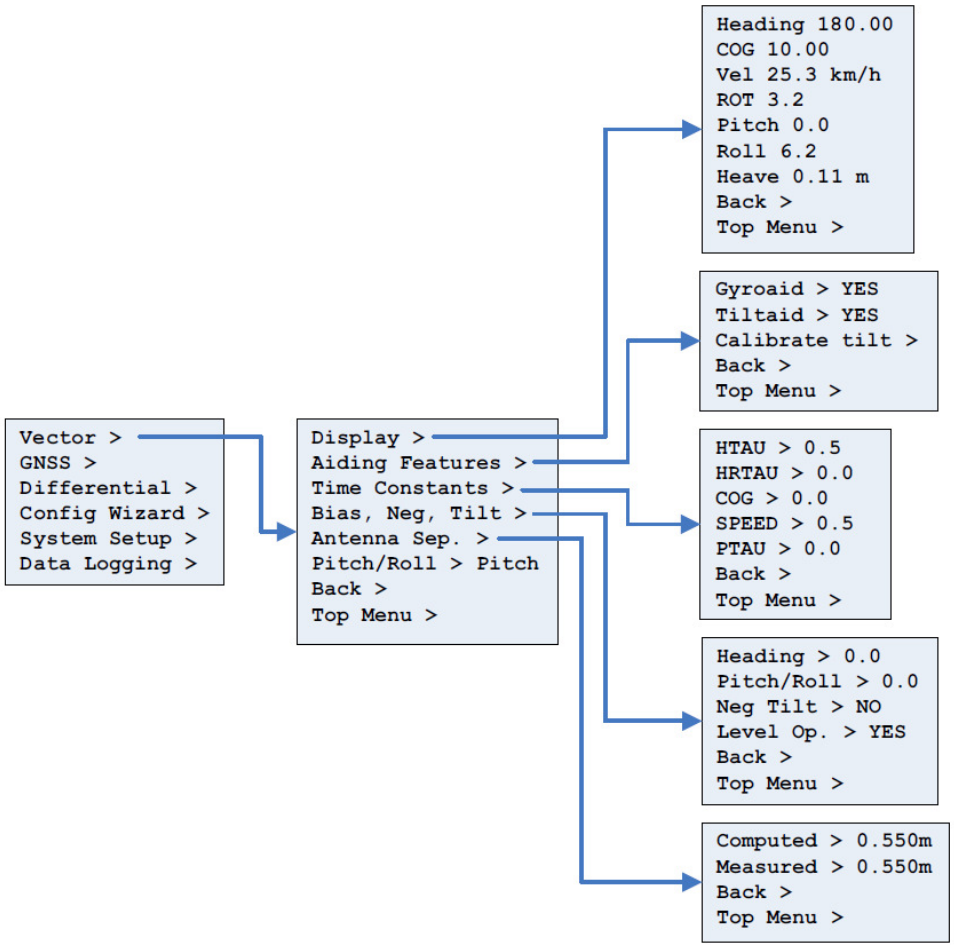


Figure C-1 Vector Menu

GNSS Menu

Use the GNSS menu to view and edit your GNSS settings. Settings include the data port outputs, specific positioning parameters, UTC time offset, and satellite visibility and positioning information.

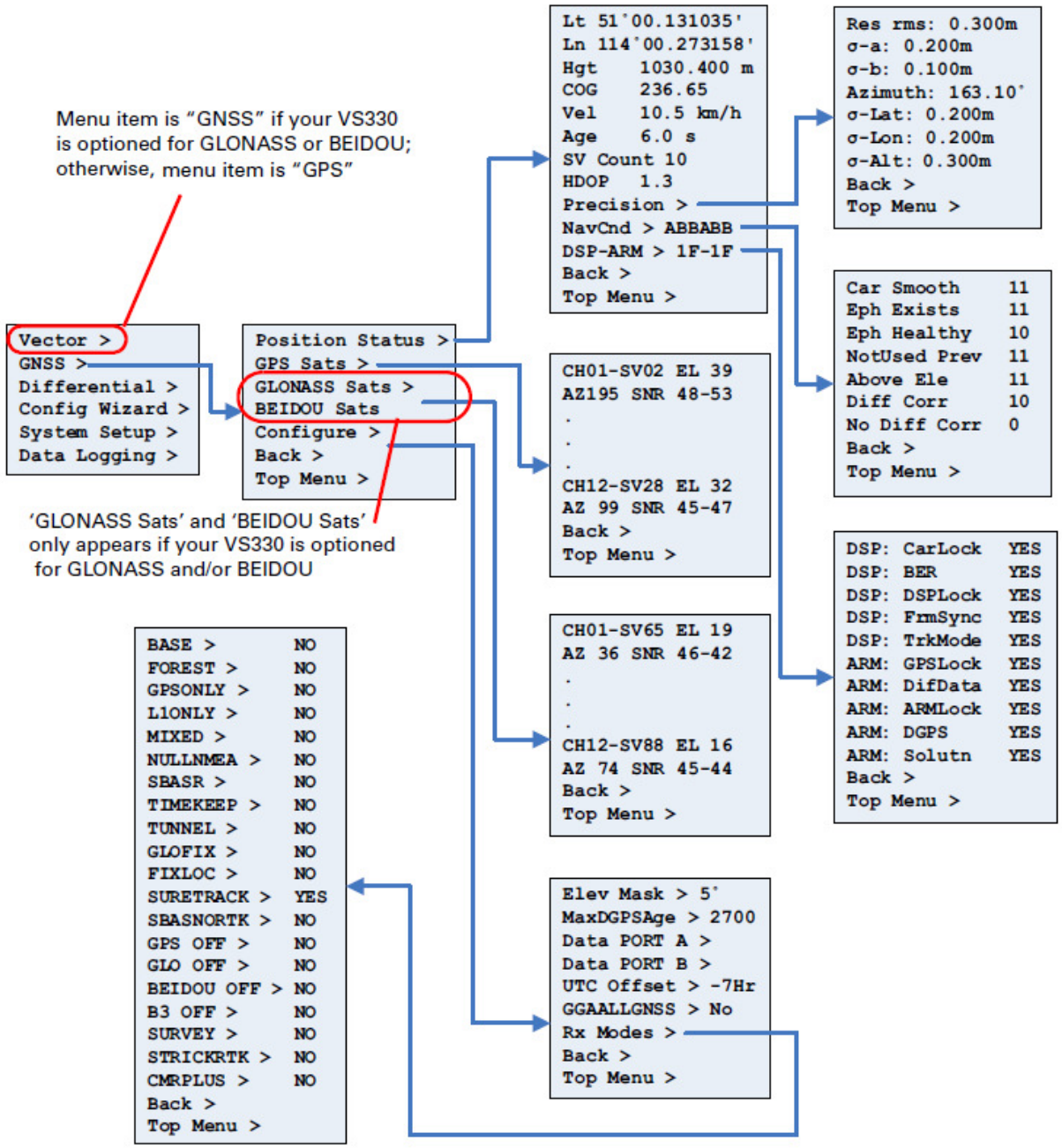


Figure C-2: GNSS Menu

Differential Menu

Use the Differential menu to view or change your differential settings. The following available differential sources depend on the configuration you purchased.

- SBAS
- Beacon (RTCM2) - available with purchased unlock code
- RTK (CMR, ROX, RTCM3)
- L-band - available with purchase of Atlas subscription
- None (Autonomous)

To select the differential source:

1. Press **Differential > Include** then set each format you may use to **Yes**. For example, if you will be using Beacon, set RTCM2 to **Yes**.
2. Press **Back** to return to the previous menu level, press **InUse**, then select your preferred differential source. For example, if you will be using Beacon, select Beacon (RTCM2 will be displayed when finished).

Figure C-3 through Figure C-7 show the complete menu maps for the SBAS, Beacon, RTK, L-band, and Autonomous, respectively. The Include menu (at right) in each of these figures shows all available formats. If you have not purchased unlock codes for L-band and Beacon, Atlas and RTCM2 (Beacon) menu items will not appear on your menu.

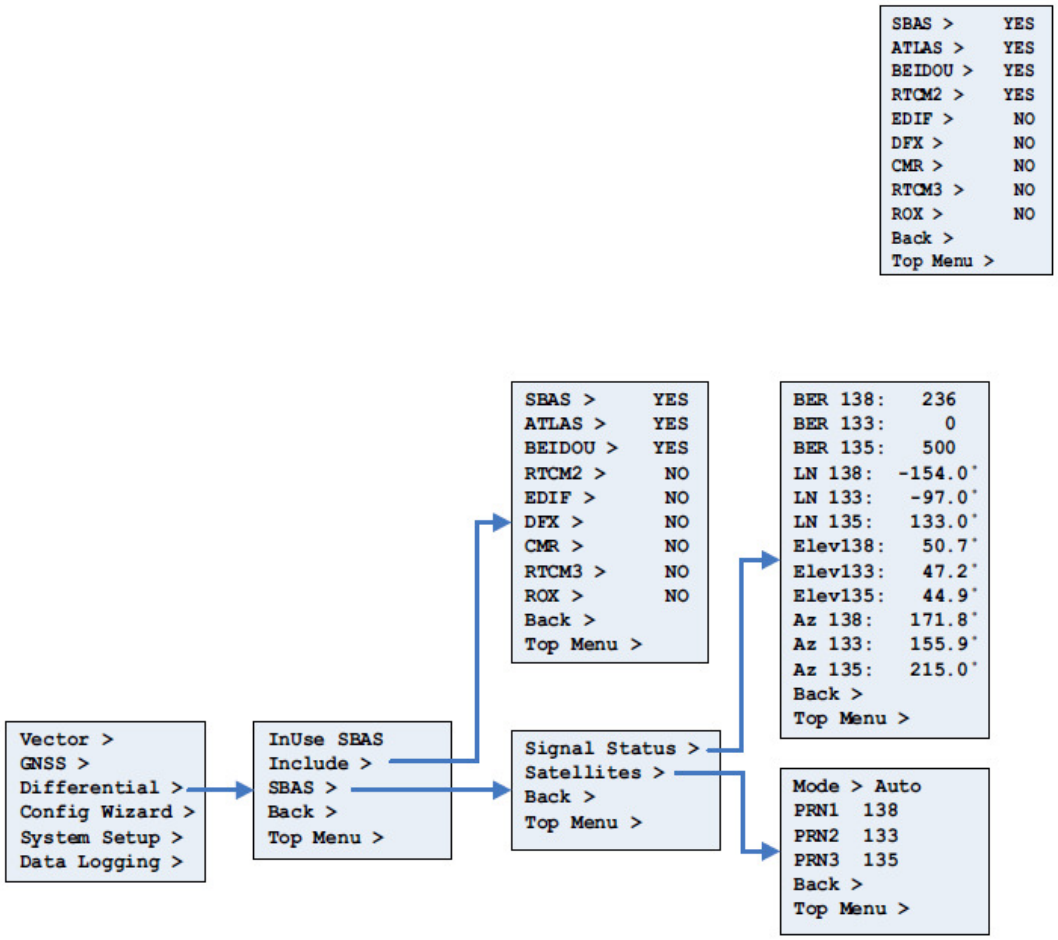


Figure C-3: SBAS Menu

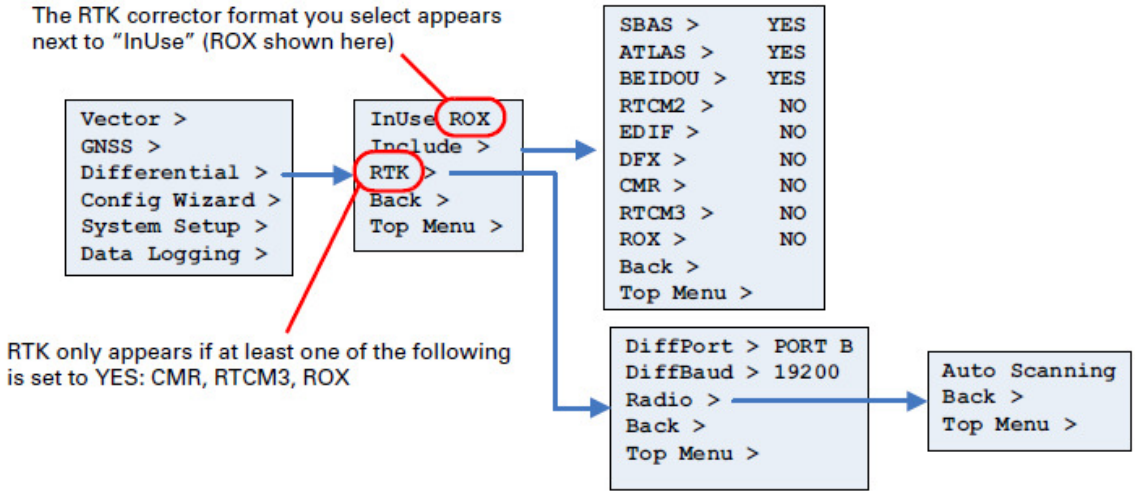


Figure C-4: RTK Menu

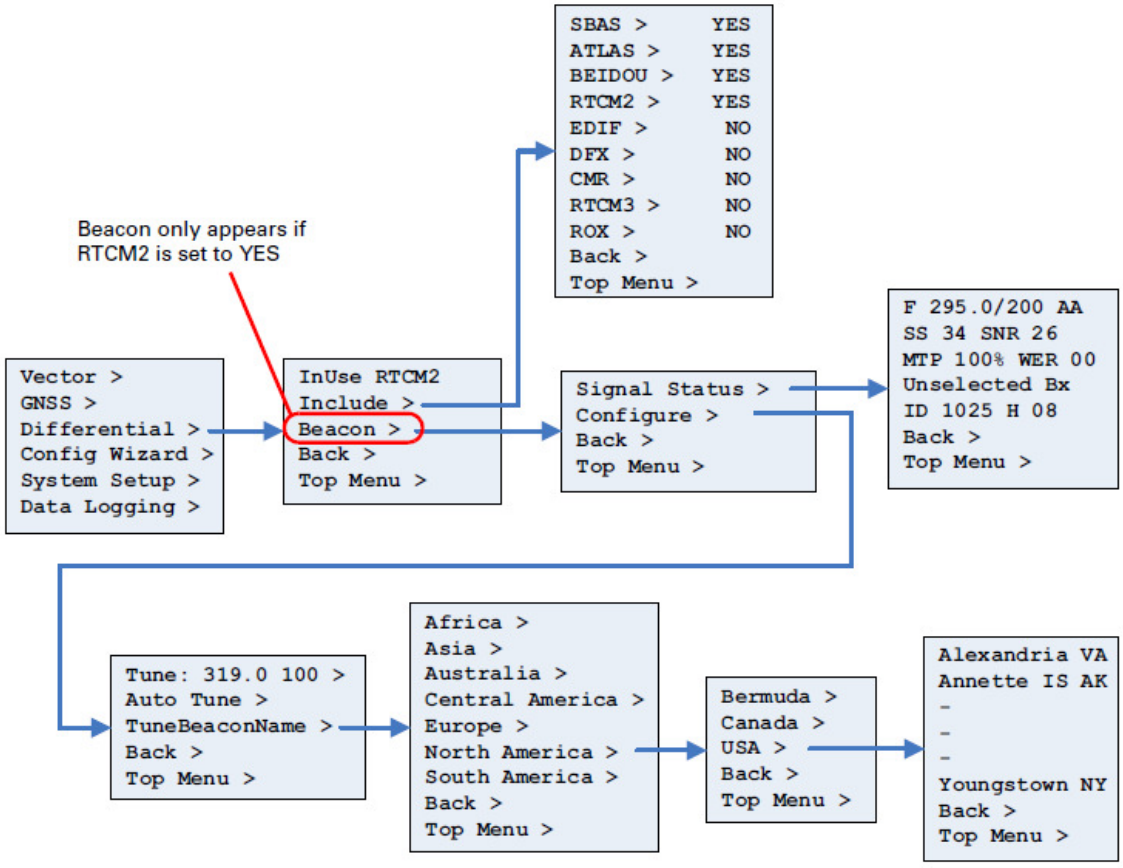


Figure C-5: Beacon Menu

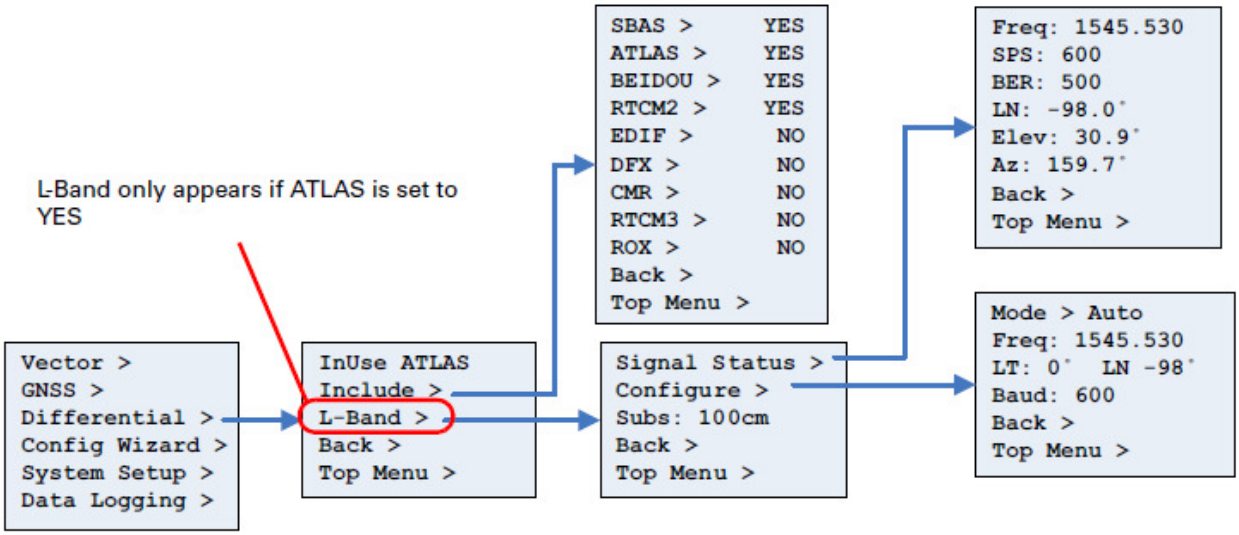


Figure C-6: L-band Menu

Figure C-7: Autonomous Menu

Config Wizard Menu

The Config Wizard walks you through basic settings to get up and running. See "Configuration Wizard" to view the Config Wizard menu map.

System Setup Menu

The System Setup menu allows you quickly view and edit current system settings. General settings include such items as current applications, units, baud rates, logs, LED contrast, subscription code, display orientation (you can flip the display 180° by selecting *YES* under *Flip Display*), and language.

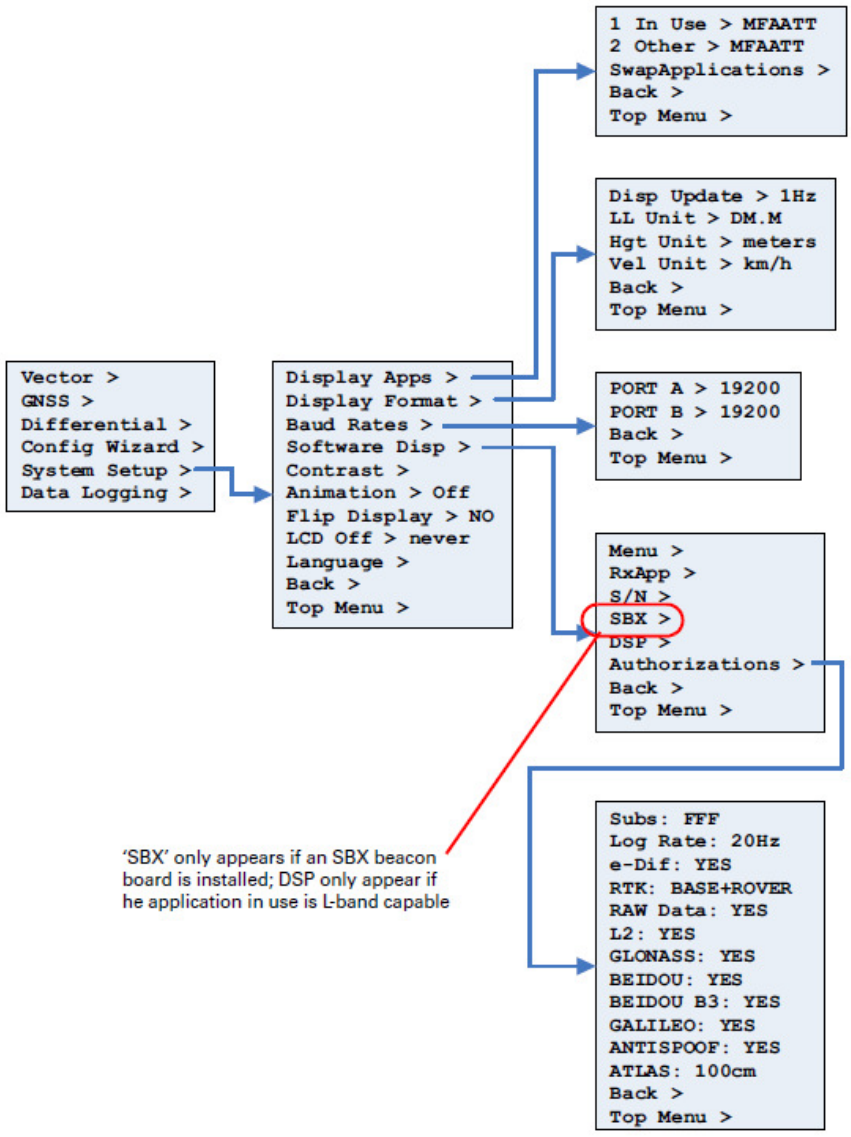


Figure C-8: System Setup Menu

Data Logging Menu

The Data Logging menu allows you to log or output job data, view USB flash drive free storage space, set up file auto-naming, and view what type of data you are logging.

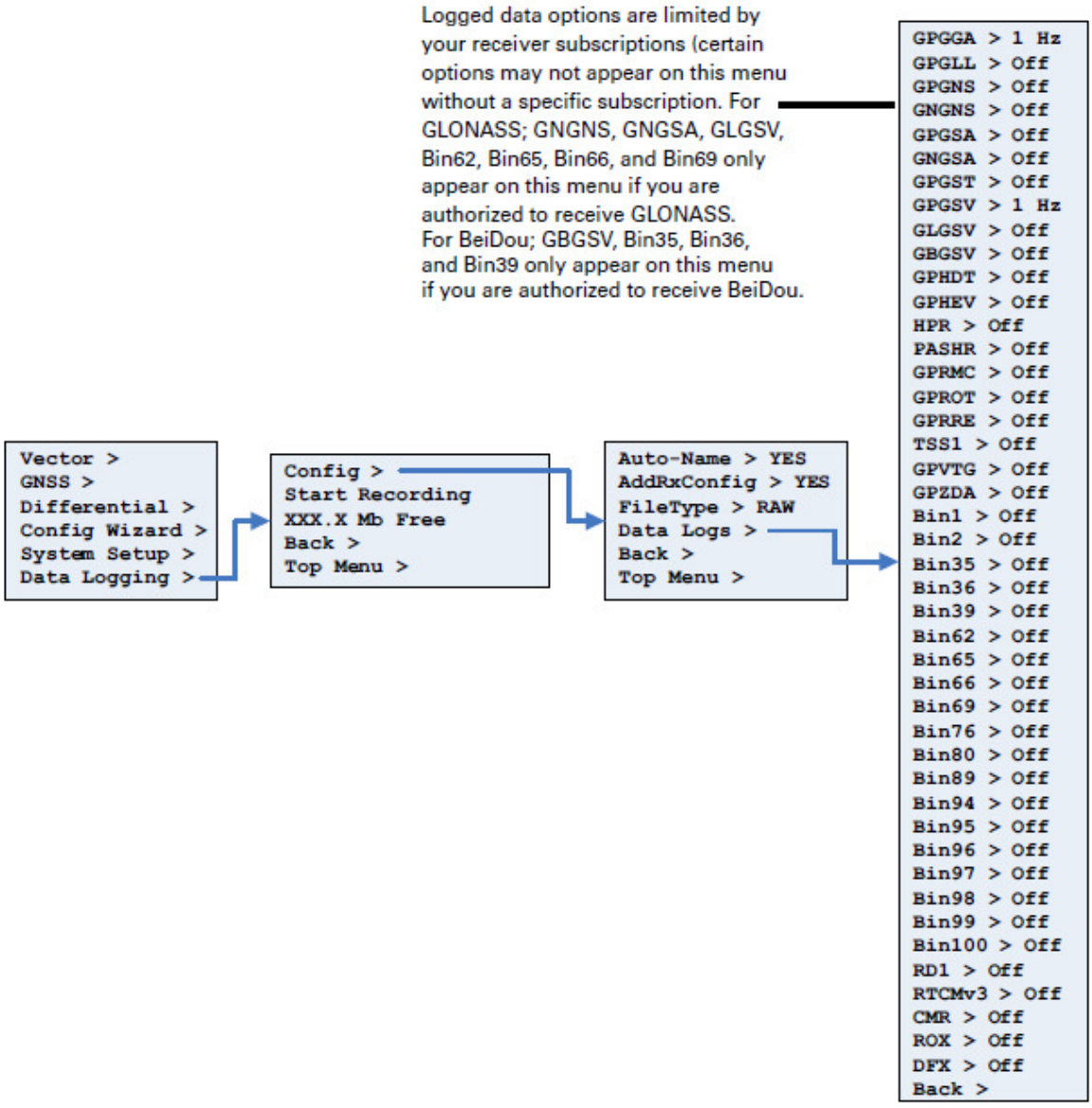


Figure C-9: Data Logging Menu

Appendix D: Technical Specifications

VS330 Receiver

A42 Antenna

A43 Antenna

A52 Antenna

Appendix D: Technical Specifications

VS330 Receiver Specifications

Table D-1 through Table D-8 list the technical specifications of the VS330.

Table D-1: VS330 GNSS Sensor

Item	Specification		
Receiver type	Vector GNSS L1/L2 RTK		
Signals received	GPS, GLONASS, BeiDou and Galileo[1]		
Channels	Two 270-channel		
GNSS sensitivity	-142 dBm		
SBAS tracking	3-channel, parallel tracking		
Update rate	10 Hz standard, 20 Hz available by subscription		
Horizontal accuracy		RMS (67%)	2DRMS (95%)
	RTK[2]	10 mm + 1 ppm	20 mm + 2 ppm
	L-band [3,4]	0.04 m	0.08 m
	SBAS (WAAS)[3]	0.25 m	0.50 m
	Beacon[3]	0.25 m	0.50 m
	Autonomous, no SA[3]	1.2 m	2.5 m
Heading accuracy	< 0.17˚ RMS @ 0.5 m antenna separation < 0.09˚ RMS @ 1.0 m antenna separation < 0.04˚ RMS @ 2.0 m antenna separation < 0.02˚ RMS @ 5.0 m antenna separation < 0.01˚ RMS @10.0 m antenna separation		
Pitch/roll accuracy	< 1º RMS		
Heave accuracy	30 cm (DGNSS), 10 cm (RTK)[5]		
Timing (1PPS) accuracy	20 ns		
Rate of turn	90º/s maximum		
Cold start time	< 40 s typical (no almanac or RTC)		
Warm start time	< 20 s typical (almanac and RTC)		
Hot start time	< 5 s (almanac, RTC, and position)		
Heading fix	< 10 s typical (valid position)		
Maximum speed	1,850 kph (999 kts)		
Maximum altitude	18,288 m (60,000 ft)		

Table D-2: VS330 Beacon Sensor

Item	Specification
Channels	2-channel, parallel tracking
Frequency range	283.5 to 325 kHz
Operating modes	Manual, automatic, and database
Compliance	IEC 61108-4 beacon standard

Table D-3: VS330 L-band Sensor

Item	Specification
Receiver Type	Single Channel
Channels	1530 to 1560 MHz
Sensitivity	-130 dBm
Channel spacing	5.0 kHz
Satellite selection	Manual and automatic
Reacquisition time	15 seconds (typical)

Table D-4: VS330 Communication

Item	Specification
Serial ports	2 full-duplex RS-232, 1 full-duplex RS-422
USB ports	1 USB-A
Baud rates	4800 - 115200
Data I/O protocol	NMEA 0183, Crescent binary[6]
Correction I/O protocol	RTCM v2.3 (DGNSS), RTCM v3 (RTK), CMR (RTK), CMR+ (RTK)[7]
Timing output	1 PPS CMOS, active high, rising edge sync, 10 kΩ, 10 pF load

Table D-5: VS330 Power

Item	Specification
Power input voltage	8 to 36 VDC
Power consumption	< 6.2 W nominal (GNSS L1/L2 L-band) < 5.3 W nominal (GNSS L1/L2 RTK)
Current consumption	< 0.52 A nominal (GNSS L1/L2 L-band) < 0.44 A nominal (GNSS L1/L2 RTK)
Power isolation	500 V
Reverse polarity protection	Yes
Antenna short circuit protection	Yes
Antenna input impedance	50 Ω

Table D-6: VS330 Environmental

Item	Specification
Operating temperature	-30°C to +70°C (-22°F to +158°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95%, non-condensing
Enclosure rating	IP66 (IEC 60529)
Shock and vibration	Mechanical Shock: EP455 Section 5.14.1 Vibration: EP455 Section 5.15.1 Random
EMC	CE (IEC 60945 Emissions and Immunity), FCC Part 15, Subpart B, CISPR 22
IMO wheelmarked certification	No

Table D-7: BS330 Mechanical

Item	Specification
Dimensions	20.2 L x 12.0 W x 7.5 H (cm) 8.0 L x 4.7 W x 3.0 H (in)
Weight	~1.1 kg (2.5 lb)
Status indications (LEDs)	Power, primary GNSS lock, secondary GNSS lock, differential lock, DGNSS position, heading, RTK lock, L-band lock
Power switch	Front panel soft switch
Power connector	2-pin ODU metal circular
Data connectors	(1) DB9 sealed (1) 9-pin ODU metal circular
Antenna connectors	(2) TNC female

Table D-8: Aiding Devices

Item	Specification
Gyro	Provides smooth heading, fast heading reacquisition and reliable < 1˚ per minute heading for periods up to 3 minutes when loss of GNSS has occurred.[8]
Tilt sensors	Provide pitch, roll data and assist in fast start-up and reacquisition of heading solution.

[1]Upgrade required

[2]Depends on multipath environment, number of satellites in view, satellite geometry, baseline length (for local services), and ionospheric activity

[3]Depends on multipath environment, number of satellites in view, and satellite geometry

[4]Requires an Atlas subscription

[5]Based on a 40 second time constant

[6]Hemisphere GNSS proprietary

[7]Receive only, does not transmit this format

[8]Under static conditions

A42 Antenna Specifications

Table D-9 through Table D-12 list the technical specifications of the A42 antenna.

Table D-9:A42 GNSS Sensor

Specification	Description
GNSS reception	GPS L1/L2/L5, GLONASS L1/L2, Beidou B1/B2/B3, SBAS, L-band, and Galileo E1/E5a and b
GNSS frequency	1.165 to 1.253 GHz 1.525 to 1.613 GHz
LNA gain	30 dB
LNA noise	2.0 dB, typical

Table D-10: A42 Power

Specification	Description
Input voltage	3.3 to 12 VDC
Input current	35 mA, typical

Table D-11: A42 Mechanical

Specification	Description
Enclosure	Aluminum base with ASA plastic cap
Dimensions	7.0 H x 13.0 D (cm) 2.9 H x 5.1 D (in)
Weight	0.38 kg (0.84 lb)
Mount	5/8” female thread
RF connector	TNC straight

Table D-12 A42 Environmental

Specification	Description
Operating temperature	-40°C to +70°C (-40°F to +158°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Enclosure rating	IP69K
Shock and vibration	EP455

A43 Antenna Specifications

Table D-13 through Table D-18 list the technical specifications of the A43 antenna.

Table D-13: A43 GNSS Sensor

Specification	Description
GNSS reception	GPS L1/L2/L5, GLONASS L1/L2, BeiDou B1/B2/B3, SBAS, L-band, and Galileo E1/E5a and b
GNSS frequency	1.165 to 1.253 GHz 1.525 to 1.613 GHz
LNA gain	30 dB
LNA noise	2.0 dB, typical

Table D-14: A43 L-band Sensor

Specification	Description
L-band frequency	1.525 - 1.585 GHz
L-band LNA gain	30 dB

Table D-15: A43 Beacon Sensor

Specification	Description
Beacon frequency	283.5 - 325 kHz
Beacon LNA gain	30 dB

Table D-16: A43 Power

Specification	Description
Input voltage	5 to 12 VDC
Input current	40 - 50 mA, typical

Table D-17: A43 Mechanical

Specification	Description
Enclosure	Lexan
Dimensions	10.4 H x 14.5 D (cm) 4.1 H x 5.7 D (in)
Weight	0.73 kg (1.6 lb)
Mount	1" coarse thread (5/8" adapter available)
Connector	TNC

Table D-18: A43 Environmental

Specification	Description
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Operating temperature	-40°C to +70°C (-40°F to +158°F)
Enclosure rating	IP69K
Shock and vibration	EP 455

A52 Antenna Specifications

Table D-19 through Table D-22 list the technical specifications of the A52 antenna.

Table D-19: A52 GNSS Sensor

Specification	Description
GNSS reception	GPS L1/L2/L5, GLONASS L1/L2, BeiDou B1/B2/B3, SBAS, L-band and Galileo E1/E5a and b
GNSS frequency	1.165 to 1.253 GHz 1.525 to 1.613 GHz
LNA gain	30 dB
LNA noise	2.0 dB, typical

Table D-20: A52 Power

Specification	Description
Input voltage	3.3 to 12 VDC
Input current	35 mA, typical

Table D-21: A52 Mechanical

Specification	Description
Enclosure	Aluminum base with ASA plastic cap
Dimensions	7.6 H x 18.5 D (cm) 3.0 H x 7.3 D (in)
Weight	0.78 kg (1.71 lb)
Mount	5/8” female thread
RF connector	TNC straight or right angle

Table D-22: A52 Environmental

Specification	Description
Operating temperature	-40°C to +70°C (-40°F to +158°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Enclosure rating	IP69K
Shock and vibration	EP455

Note: The phase center variation is less than 3 mm at GPS L1 and L2 for elevations above 15 degrees.

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Scottsdale, AZ 85255, USA
Phone: +1-480-348-6380
Fax: +1-480-270-5070
techsupport@hregnss.com www.hgnss.com

Hemisphere GNSS Inc.
8515 East Anderson Drive, Suite A
Scottsdale, Arizona, US 85255

Phone: 480-348-6380
Fax: 480-270-5070
precision@hgnss.com
www.hgnss.com